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INSTRUMENTATION OBSERVATIONS FROM THE U-FRAME LOCK OF THE ARKANSAS RIVER LOCK AND DAM 5.

by

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P. O. Box 631, Vicksburg, Miss. 39180

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Arkansas River Lock and Dam 5 is a U-frame lock coupled with a nonnavigable dam located between Pine Bluff and Little Rock, Arkansas, at river mile 128. The object of the study is the U-frame lock. The lock is a reinforced concrete structure with a 110- by 600-ft chamber. Previous U-frames have been instrumented, but Lock 5 provided a test case for a lock structure founded on Tertiary-age clay.

CONT

(Continued)

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20. ABSTRACT (Continued).

CONT

The instrumentation was provided to determine the validity of design assumptions and to use in design of similar structures. From the data, earth and hydrostatic pressures were calculated beneath the base slab and along the walls, while the stresses and strains within the slab and walls were also obtained.

Overall, it appears the instruments were operating satisfactorily until September 1969 at which point a reduction in personnel precluded acceptable engineering measurements. Considerable judgment must be exercised when interpreting data collected after this point in time. A set of conditions, as specified in the design cases, had occurred before the September 1969 date, and only the dewatered case and possibly a more accurate normal operating case require data for analysis.

Based on the soil stresses under the lock, it appears that the stress curves are similar in shape to the ones plotted for Old River and Port Allen with large stresses under the lock walls and much less under the lock floor. Concrete strains and stresses are shown for the design cases chosen for the soil stress cases. No attempt is made in this report to analyze the structural response.

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Preface

The investigation reported herein was one phase of a project entitled "Analysis of Structure and Foundation Interaction," sponsored by the Office, Chief of Engineers (OCE), U. S. Army, under CWIS 31203. The investigation was conducted by the U. S. Army Engineer Waterways Experiment Station (WES) during the period FY 74-FY 76.

This report was prepared under the general supervision of Messrs. J. P. Sale, Chief, Geotechnical Laboratory; C. L. McAnear, Chief, Soil Mechanics Division; and G. B. Mitchell, Chief, Engineering Studies Branch (ESB). Mr. Lucian G. Guthrie was the OCE Technical Monitor. Preparation of the data was made by Mr. W. L. Hanks (ESB). Mr. Roy E. Leach (ESB) prepared this report.

Directors of the WES during the investigation and preparation of this report were COL G. H. Hilt, CE, and COL J. L. Cannon, CE. Technical Director was Mr. F. R. Brown.

Contents

Conversion Factors, U. S. Customary to Metric (SI) Units of Measurement

U. S. customary units of measurement used in this report can be converted to metric (SI) units as follows:

Multiply	By	To Obtain
cubic feet	0.02831685	cubic metres
cubic yards	0.7645549	cubic metres
degrees (angle)	0.01745329	radians
feet	0.3048	metres
inches	25.4	millimetres
microinches per inch	0.001	microns per millimetre
miles (U. S. statute)	1.609344	kilometres
pounds (force) per square inch	6.894757	kilopascals
pounds (mass)	0.4535924	kilograms
seconds (angle)	0.000004848137	radians

INSTRUMENTATION OBSERVATIONS FROM THE U-FRAME LOCK OF THE ARKANSAS RIVER LOCK AND DAM 5

Introduction

Background

1. Arkansas River Lock and Dam (L&D) 5 is one of 13 in an overall plan to develop the Arkansas River basin from Catoosa, Oklahoma, to the Mississippi River as authorized by the River and Harbor Act of 24 July 1946. Each lock has a 110- by 600-ft* chamber with normal lifts ranging from 14 to 54 ft and each is connected to a nonnavigable dam. For the purpose of checking design values or operational status, each lock was instrumented to some degree with L&D 5 being the most heavily instrumented.

Purpose

2. The purpose of this study is to take 8 years of instrumentation data from Lock No. 5 and report it in such a manner that it can be used later in other studies, such as a finite element analysis. Included is a discussion of the quality of the data and a brief comparison of measured values with design cases for several soil-structure interaction cases.

Location and description of the structure

3. Lock No. 5 is located between Pine Bluff and Little Rock, Arkansas, at river mile 128. It is a 110- by 600-ft reinforced concrete U-frame lock with a design normal lift of 17 ft. Design upper pool, el 213,** is controlled with a gated dam connecting the riverside wall of the lock and the opposite riverbank. The 600-ft semigravity-type guide walls and the lock chamber are founded on Tertiary-age clay.

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* A table of factors for converting U. S. customary units of measurement to metric (SI) units is presented on page 4.

** All elevations (el) cited herein are in feet referred to mean sea level (msl).

Description and Location of Electrical Measuring Devices

4. Experience obtained at two other U-frame locks, Old River and Port Allen, helped in determining the type and location of the needed instrumentation. The task was to measure soil-structure interaction and to determine load transfers, stresses, and strains in the concrete. All 95 electrical devices, including concrete strain and stress meters, joint meters, pore pressure cells, and soil stress meters, were installed in two monoliths.

5. The special structural safety instrumentation devices are installed across monolith 11, a gate bay monolith, and monolith 18 in the central portion of the lock chamber. Location of the devices are as shown in Plates 1 and 2 and include:

a. Carlson concrete strain meters (SM-1 to SM-23) to determine strain across and through the center of the lock floor slab and walls.

b. Carlson concrete stress meters (CS-1 to CS-16) to determine the magnitude and distribution of stress in the floor and walls at points where compressive stress can be reasonably predicted.

c. Carlson soil stress meters (SS-1 to SS-30) to determine, in conjunction with applicable piezometer data, effective earth pressures beneath the lock and against the walls.

d. Carlson pore pressure cells (PP-1 to PP-18) to determine pore pressure gradients in the lock floor horizontal lift joints.

e. Joint meters (JM-1 to JM-8) to determine the load transfer in the closure section of the lock.

f. Piezometers, as shown on Plate 2, to determine the hydrostatic pressure in the vicinity of the soil stress meters.

Observations

General

6. Normal observational procedures were followed for each device. A reading was taken immediately before and after concrete was placed around each meter, and a third was taken one day later to establish a

zero reading. After the zero reading was established, a time schedule for recording data was to be followed. This schedule was flexible in that milestones or problems in construction were incorporated, such as completion of a concrete pour, completion of a stage of construction, or development of some anomaly that warranted investigation.

7. Starting in February 1966 or the date of installation, most of the gages were read 30 to 50 times the first year and only an additional 70 to 100 times through August 1974. Due to personnel reductions from June 1967 forward, no rigid data collection schedule was followed, and some large gaps exist in the information recorded. Instrumentation readings were made only two times between June 1967 and July 1968 and only five times from October 1969 to February 1972. Although the initial conditions through June 1967 appear to be adequately defined, engineering experience and judgment must be relied upon when interpreting the data collected beyond that point. These factors also preclude obtaining adequate histories of the site and instrument conditions needed for interpretation.

Concrete strain meters

8. The observed strains and the stresses computed from the strains are shown in Plates 3-30. After the strains caused by the initial lifts of concrete have stabilized, it appears from the data that long-term strain is temperature dependent with the largest values of tension occurring in the winter and lesser values in the summer. This agrees with the conclusions for two other locks with which the U. S. Army Engineer Waterways Experiment Station has been involved. Other than these seasonal changes, a variation is apparent during the cutoff of the dewatering system and flooding of Cofferdam II surrounding the dam and gates. Construction history is not complete enough to explain the sharp changes.

9. Maximum allowable tensile stress for concrete was determined from the following equation:

$$\tau = 7.5\sqrt{f'_c} \tag{1}$$

where

τ = tensile stress, F/L^2

f'_c = compressive strength of concrete, F/L^2

By substituting 3000 psi for f'_c , τ is calculated to be ~ 400 psi. Values of strain corresponding to 400-psi stress on the "Observed Strain" (Plates 3-30) average 100 µin./in. With these values as rough approximations for cracking of the concrete, Plates 7 and 11 show that cracking would be indicated. However, these particular strain meters are installed in a spider arrangement, and further study might negate this conclusion. Several other gages show brief periods where the strain was higher than 100 µin./in., but the allowable tensile strain of the concrete might have been larger than these temporary strains and the 100 µin./in. value is only an approximation.

Concrete stress meters

10. The observed concrete stresses are shown in Plates 31-41. In general, the data range from 0 to 200 psi (compression) up until late 1969. The main exceptions are:

a. CS 9 - data shift to tension noted in 1968.

b. CS 12 - very large tension values occur after early 1967.

c. CS 13 - data plot shows tension through 1967 and then a sudden shift to > 700-psi compression.

d. CS 15 - in late 1968, values shift to > 4000-psi compression.

The continuation sheets for each concrete stress meter start with data plotted for December 1971 after a discontinuation of readings in September 1969. In most cases, values computed to be in tension were > 50 percent of the total number of data points, while approximately 50 percent of all the gages had sudden large shifts or fluctuations in values.

Soil stress meters

11. Effective stresses (total stress minus hydrostatic pressure) for the soil stress meters are shown in Plates 42-65. Since effective stress is shown, a plot of hydrostatic pressure for the piezometer nearest the soil stress meter is also presented for comparison purposes. Data coverage for the soil stress meters is fair for the period up

through September 1969; most of the changes, i.e. peaks and slopes, can be related to some phase of construction, but thereafter the data are questionable. The measured soil stress under the floor and the walls increased as the additional lifts of concrete were added. But then, after the dewatering system was discontinued and the hydrostatic head was allowed to rise, the stresses were relieved somewhat by the uplift pressure on the base of the slab. Soil stresses against the landside wall increased as the fill was brought up and then decreased slightly as the hydrostatic head was allowed to rise.

Pore pressure cells

12. The pore pressure cell data for gages PP-1 through PP-18 are shown in Plates 66-75. Data from 14 of the 18 gages are essentially zero or negative for the period up through 1968. The mechanics of the gage itself (water pressure deflecting a diaphragm attached to a strain gage) indicate that only very small negative readings are possible, and therefore the negative readings are somewhat questionable. One explanation put forth by the manufacturer is that for the earlier instruments, aggregate in the concrete could possibly deform the part of the meter containing the strain gage and thereby create an electrical reading that would convert into negative pressures.

13. By accepting this explanation and assuming the gages are reliable, a definite rise in hydrostatic pressure in the concrete is evident starting in late 1968 with three gages (1, 4, and 16) showing as much as 30 ft of head by mid 1969. The project, both lock and dam, was completed in late 1968. The dewatering system shut-down, the breaching of the last cofferdam, and the differential head on the lock are believed to be the factors causing the rise in hydrostatic pressure in the concrete. All data past 1969 are questionable; therefore, no trends can be established, and no verification of the high pressures can be made without reliable, up-to-date data.

Joint meters

14. Data collected from joint meters 1-8 are shown in Plates 76-79. The joint meters (Plate 2) were installed to determine load transfer by rotation or sliding. To determine movement in the vertical plane,

meters 2 and 7 were installed 45 deg from the horizontal with the downstream end being up, while meters 3 and 6 were installed 45 deg from the horizontal with the downstream end being down. A comparison of the data (Plates 76-79) shows that there is movement but that meters 3 and 6 have twice as much movement as 2 and 7. This indicates that the space between the joint has widened. That an outward rotation of the bottom of the joint has also occurred is evidenced by the differential movement. To determine movement in the horizontal plane, meters 1 and 8 were installed horizontally and 45 deg from the center line of the lock with the downstream end being to the right, while meters 4 and 5 were installed in the same manner with the downstream end being to the left. The magnitude of the data for these meters indicates outward movement (expansion of the joint) but no differential movement or rotation in the horizontal plane.

Piezometers

15. Data collected from each piezometer are not presented but are incorporated as uplift pressures on the soil stress meter plots.

Discussion

Soil stresses under the lock

16. It is not the purpose of this report to present a thorough analysis of the lock, but an effort was made to determine the acceptability of the present data. For comparison, measured values for the conditions that most nearly match design conditions are plotted versus the design values.

17. Plate 80 shows conditions as specified for the design cases, which are referred to as the construction, normal operating, and extreme maintenance cases. Other design conditions were checked, but only these will be considered. Each case incorporates a set of soil and water conditions from which pressures exerted on the lock can be calculated. Up to the present, two of the design cases have occurred, i.e. construction and normal operating. Comparisons of the measured and design pressures beneath the lock for selected cases are shown in Plates 81-84 for monoliths 11 and 18. The design data were computed using

a "Beam on Elastic Foundation" analysis based on an IBM 650 Computer analysis furnished to the Fort Worth District by the Buffalo District.

18. Design conditions during construction (lock complete and dewatered) for monolith 18 were most nearly duplicated on 27 May 1967, and a comparison with measured values is shown in Plate 81. The stress data for the curve labeled "computed (Σ FORCES)" were obtained by taking the total weight for each section (two walls and the lock floor), dividing by the area of each to obtain total pressure, then subtracting the uplift pressure to obtain effective stress. This curve is presented for use in determining a range for the actual measured forces. For the construction case shown (27 May 1967), there is good agreement for all three curves under the land-side wall and the lock floor. Under the river-side wall, there is some difference in the curves, but this might have been smaller had there been more data points for the measured and computed curves (beam). It should be noted that for the construction case, the soil properties and existing forces should be more nearly known, thus the close agreement between design and measured stresses. As mentioned earlier, the Port Allen and Old River designs were considered during the Lock No. 5 design, for the general shape of the measured stress curves for the three locks is similar under the land-side wall and the lock floor. Since there is no overburden other than water outside the river-side lock wall, the measured stress under that wall is less than the stress under the land-side wall.

19. For the normal operating case with the lower pool in the lock at el 196 (case I-A monolith 18, Plate 80), design conditions were most nearly met on 23 December 1968. A comparison of design and measured values is shown in Plate 82. Again, there is agreement for the distribution of stresses under the land-side wall and the floor slab, but the data are scattered under the river-side wall. The same observations apply to the normal operating case where the upper pool is in the lock (case I-A, Plate 80) as indicated in Plate 83.

20. The data for the construction case for monolith 11 are shown in Plate 84. Again, the same type curve for the measured stresses is apparent with large stresses under the walls and lesser stresses under

the slab. The design curve (beam on an elastic foundation) is much flatter and does not show the high stresses under the lock walls.

Stress and strains
in the lock floor slab

21. Stresses in the concrete were measured directly with concrete stress meters and were also calculated from strain meters located at the same points. These data (Plates 85-87) are presented for the same three cases shown previously in Plates 81-84. The stresses at the center line of the lock are within a range of 400 psi, while the gages located near the construction joint measured stresses within a range of 800 psi. Data collected from SM 13 and SM 15 indicate tensile stresses for all three cases near the construction joint located to the river-side of the center line. This cannot be verified by the concrete stress meters since they only measure compressive stress. A high compressive stress is indicated by data from gage CS 12 (top of the slab) near the construction joint land-side of the center line. This stress is not verified by the strain meter SM 19. The stresses in the lock floor slab are complicated near the joint; therefore, a thorough analysis would need to be performed before any conclusions could be drawn from the data.

22. Strains calculated from data collected near the same construction joints mentioned above are shown in Plates 88-90. These data indicate mostly tensile strains in the lock floor slab for all three cases. After the construction case (Plate 88), the strains in the top of the slab became more tensile, while the strains in the bottom of the slab became less tensile to the extent of even becoming compressive for case I-A (Plate 89). If the strains are tensile, then this is an explanation for the erratic behavior of the concrete stress meters mentioned above since they cannot measure tensile forces.

23. For monolith 18, Plate 91 presents the observed rebound due to the excavation of the foundation. Heave points (HP) 4 and 5 were located beneath the land-side and river-side walls, respectively, while HP 6 was located on the center line of the lock. The subsequent settlements are listed in Table 1. The construction settlement plug is located on the outside toe of the walls, but the settlement reference

points are on the top of the wall. If it is assumed that there is no rotation of the walls, the settlements can be added for a maximum of 0.963 and 0.856 in. for the land-side and river-side walls, respectively. This compares with measured rebound of 0.9 and 0.75 in. for the land-side and river-side walls, respectively.

Conclusions

24. Based on the limited analysis and observations of the instrumentation devices, it is concluded that most of the devices were operating satisfactorily at least until September 1969, but after this time much engineering judgment must be exercised in data interpretation. If current data are needed for future studies, a thorough instrument check would have to be performed and new data collected.

25. Furthermore, based mainly on the measured soil stresses under the lock, the subgrade reaction curves have the general shape of these measured at Old River and Port Allen Locks, i.e., larger stresses under the lock walls with much less under the lock floor. The less compressible foundation at L&D 5 appears to cause much larger subgrade reactions beneath the land-side face of the land-side wall than at either of the other locks, where the foundations are much more compressible. Although it is beyond the scope of this report to analyze the structural stresses, after the lock was flooded and the uplift pressure and the downward force of the pool in the lock were stabilized, the slab itself flexed upward in the middle. This situation produced more tensile strain in the top of the slab and less near the bottom.

Table 1

Construction Settlement Data

No.	1966 3 Jun	1966 26 Jun	1966 10 Jul	1966 13 Sep	1966 13 Oct	1966 10 Nov	1967 7 Feb	1967 3 Mar	1967 25 May
				Settlement Plug Readings*					
R-18	0.0	-0.8	-0.06	0.0	-0.05	0.0	0.1**	-0.22	--
L-18	--	--	0.0	-0.19	-0.16	-0.2	-0.13	-0.12	-0.52

Reference Point Readings

	12 Jun 1967	14 Jun 1968	25 Feb 1969	6 Jun 1969
L18U	0.0	-0.540	--	-0.768
L18D	0.0	-0.480	-0.768	-0.720
R18U	0.0	-0.468	-0.660	-0.600
R18D	0.0	-0.456	-0.636	-0.600

Note: Data taken from draft of: CWI Item No. 039, Arkansas River Lock and Dam Structural Studies, Arkansas River and Tributaries, Arkansas and Oklahoma, Report No. 3, Vertical Displacement of Foundation Soils (Unloading and Loading Conditions), June 1971.

* Points picked off curve.

** Heave upward.

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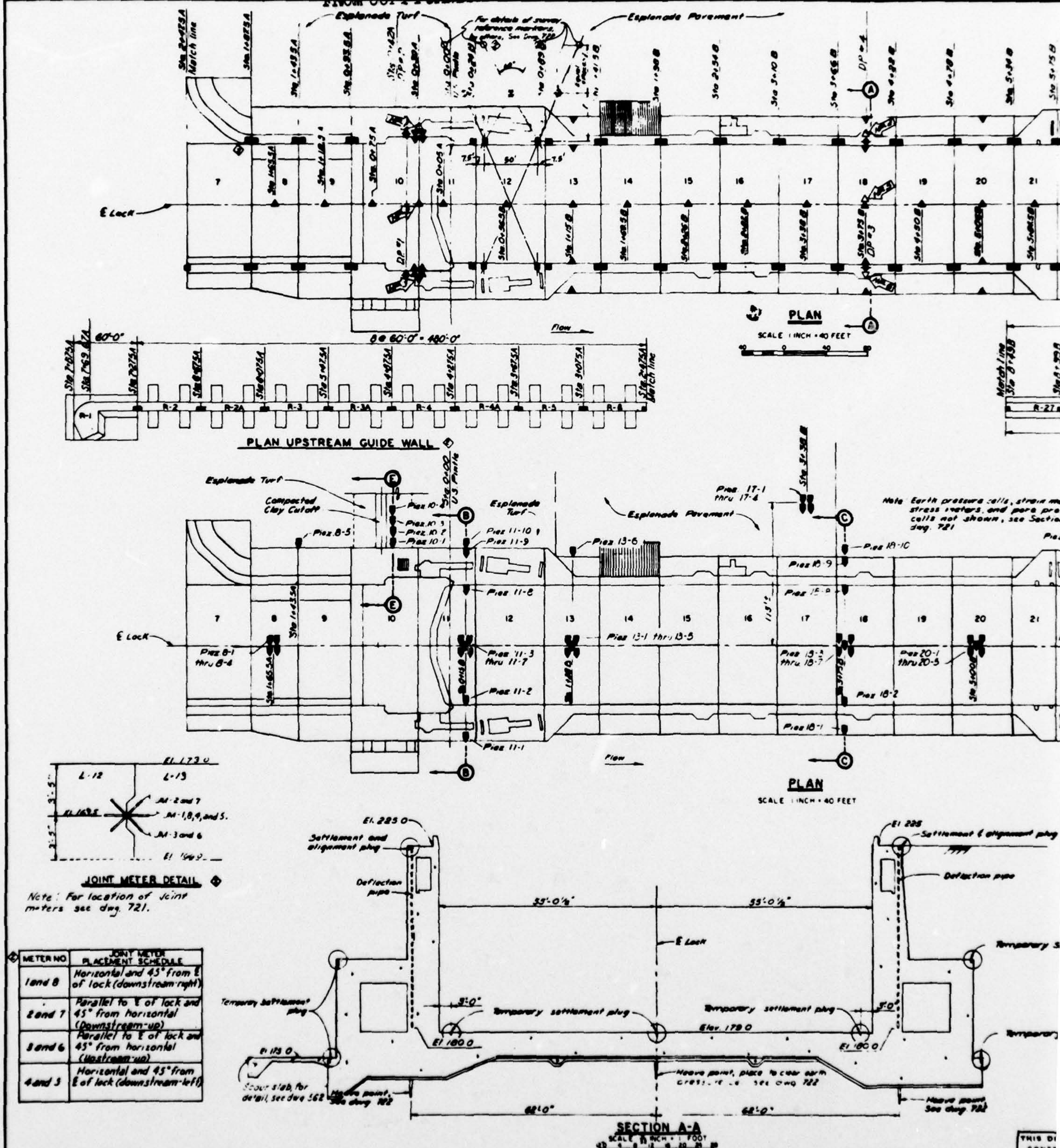

METER NO.	JOINT METER PLACEMENT SCHEDULE
1 and 8	Horizontal and 45° from ℄ of lock (downstream-right)
2 and 7	Parallel to ℄ of lock and 45° from horizontal (Downstream-up)
3 and 6	Parallel to ℄ of lock and 45° from horizontal (Upstream-up)
4 and 5	Horizontal and 45° from ℄ of lock (downstream-left)

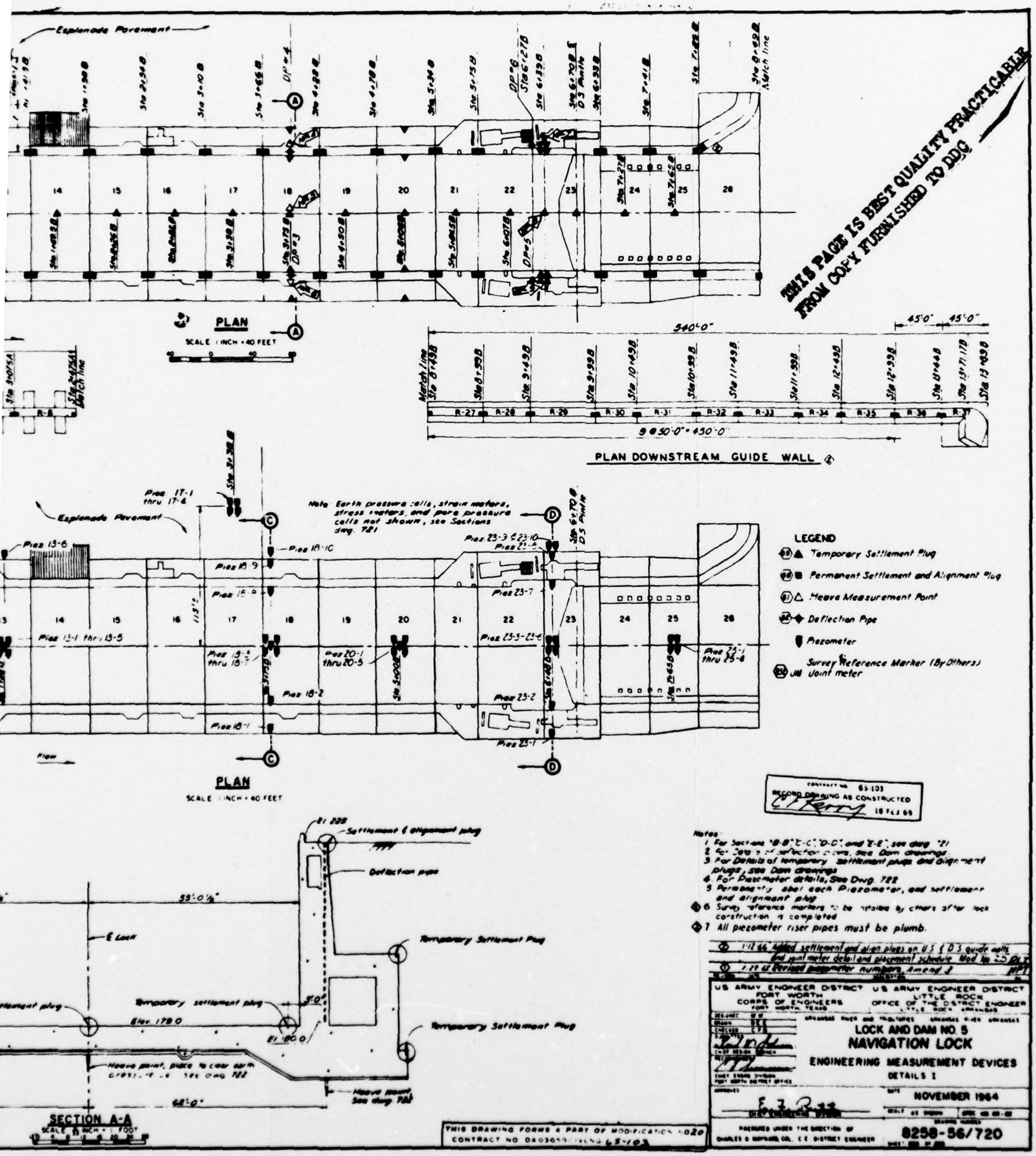
Esplanade Pavement
PLAN
SCALE 1 INCH = 40 FEET
PLAN DOWNSTREAM GUIDE WALL
9 @ 50'-0" = 450'-0"
540'-0"
45'-0"
45'-0"
Note: Earth pressure cells, strain meters, stress meters, and pore pressure cells not shown, see Sections dwg. 721
LEGEND
Temporary Settlement Plug
Permanent Settlement and Alignment Plug
Heave Measurement Point
Deflection Pipe
Piezometer
Survey Reference Marker (By Others)
Joint meter
PLAN
SCALE 1 INCH = 40 FEET
Settlement & alignment plug
Deflection pipe
Temporary Settlement Plug
Temporary settlement plug
Temporary Settlement Plug
SECTION A-A
CONTRACT NO. 65-103
RECORD DRAWING AS CONSTRUCTED
Notes:
4. For Piezometer details, See Dwg. 722
7. All piezometer riser pipes must be plumb.
US ARMY ENGINEER DISTRICT, FORT WORTH, CORPS OF ENGINEERS
US ARMY ENGINEER DISTRICT, LITTLE ROCK, OFFICE OF THE DISTRICT ENGINEER
LOCK AND DAM NO. 5
NAVIGATION LOCK
ENGINEERING MEASUREMENT DEVICES
DETAILS I
NOVEMBER 1964
8258-56/720
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PLATE 1

2

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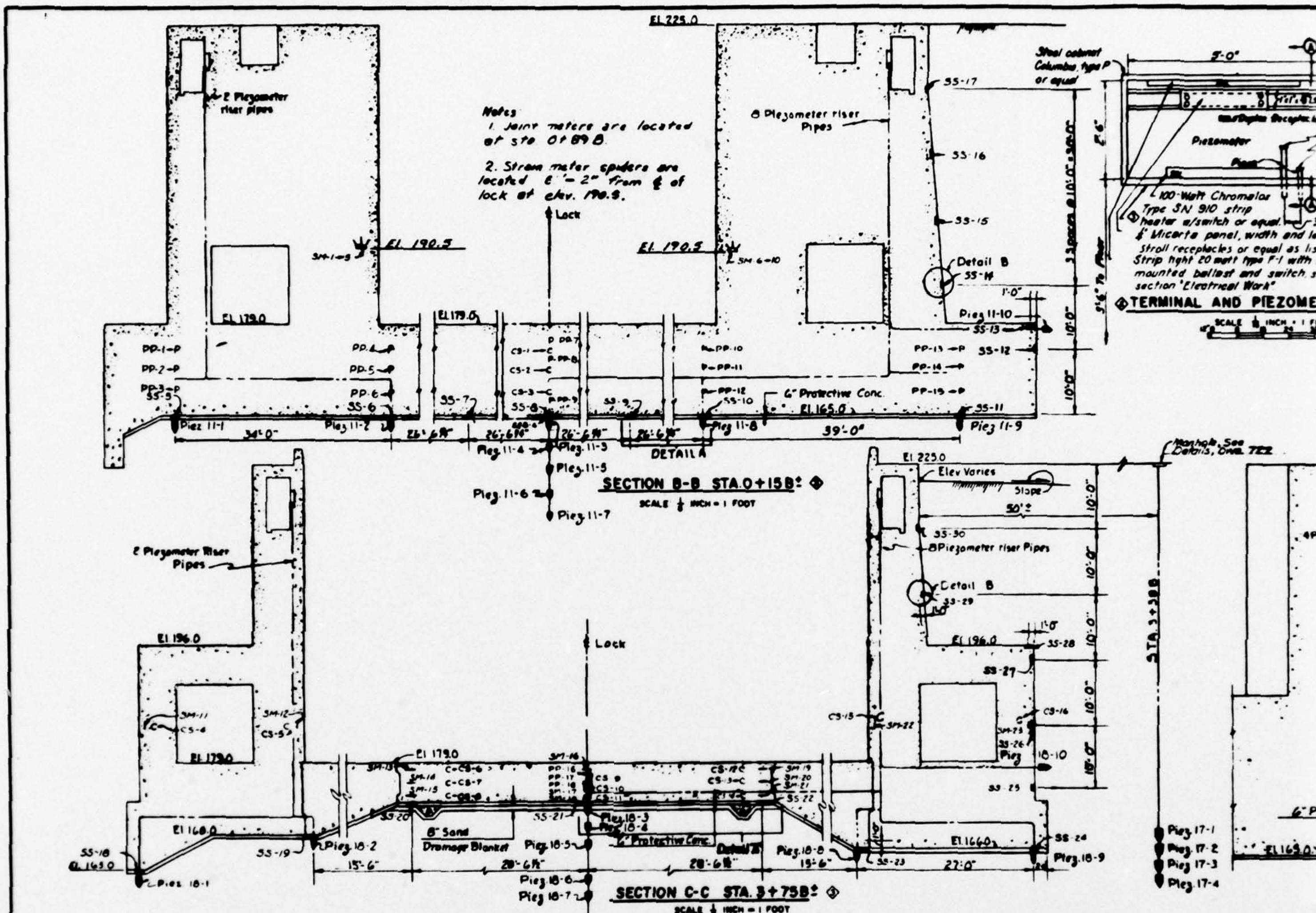
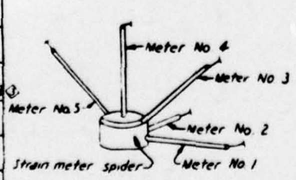


METER No.	PLACEMENT
1 and 6	Horizontal-parallel to ℄ lock (upstream)
2 and 7	Horizontal-perpendicular to ℄ lock (lock side)
3 and 8	45° From Horizontal-parallel to ℄ lock.
4 and 9	vertical
5 and 10	45° From Horizontal-parallel to ℄ lock



STRAIN METER INSTALLATION
NO SCALE

SCHEDULE OF ELECTRICAL METERS

METER NO	STATION	ELEVATION	APPROX DIST FROM ℄
SS-1	0+61 A	213.0	88'-0" L
SS-2		195.0	89'-6" L
SS-3		180.0	90'-6" L
SS-4		165.0	103'-0" L
SS-5	0+13 B	164.5	87'-0" R
SS-6			53'-0" R
SS-7			26'-6" R
SS-8			0'-0"
SS-9			26'-6" L
SS-10			53'-0" L
SS-11			97'-0" L
SS-12		175.0	103'-0" L
SS-13		179.0	102'-0" L
SS-14		185.0	91'-0" L
SS-15		195.0	90'-0" L
SS-16		205.0	89'-0" L
SS-17	0+13 B	215.0	88'-0" L
SS-18	3+73 B	162.5	81'-6" R
SS-19		167.5	56'-6" R
SS-20		172.5	28'-6" R
SS-21		172.5	0'-0"
SS-22		172.5	28'-6" L
SS-23		165.5	56'-6" L
SS-24		165.5	81'-6" L
SS-25		175.0	81'-6" L
SS-26		185.0	81'-6" L
SS-27		195.0	81'-6" L
SS-28		196.0	80'-6" L
SS-29		205.0	64'-0" L
SS-30	3+73 B	215.0	63'-0" L

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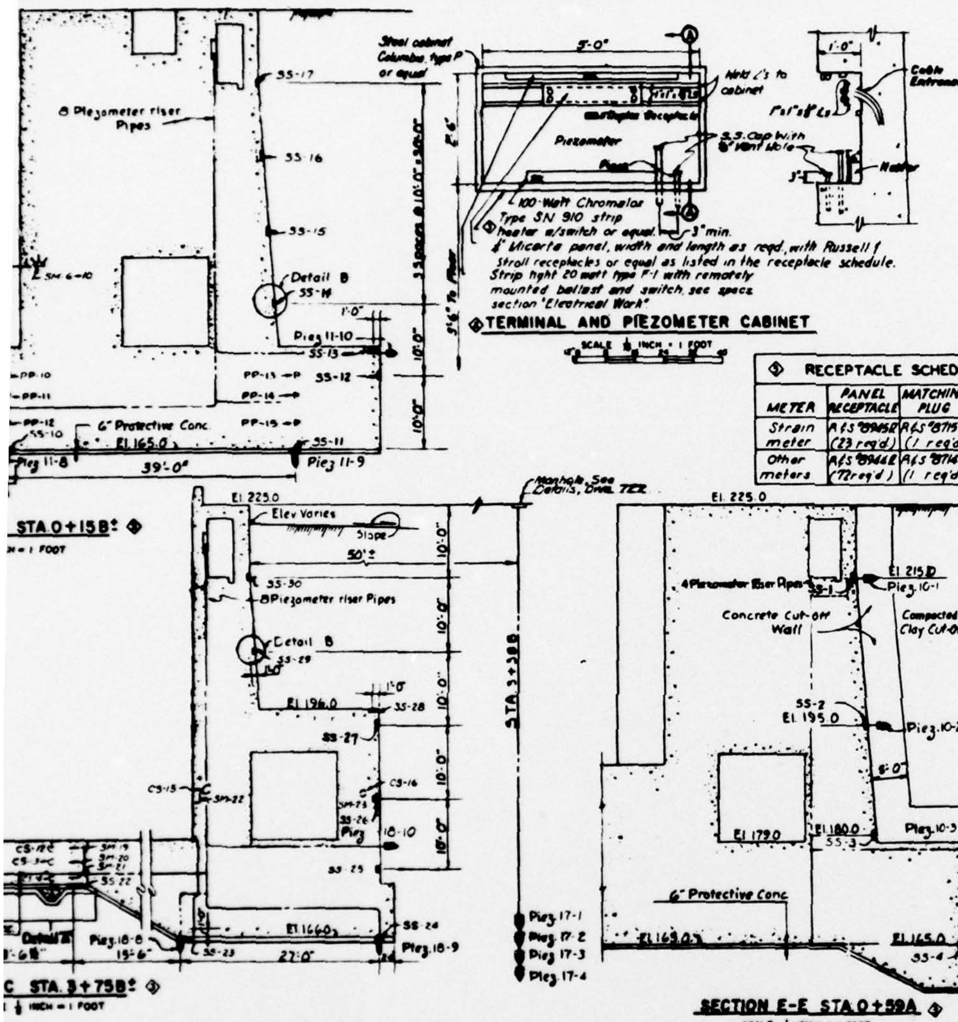
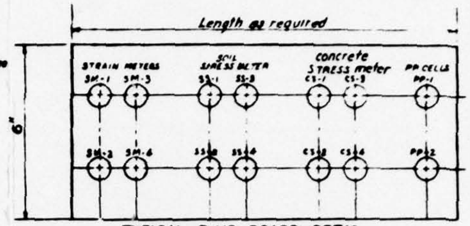


RECEPTACLE SCHEDULE			
METER	PANEL RECEPTACLE	MATCHING PLUG	CABLE
Strain meter	R&S #8945R (23 req'd)	R&S #8715R (1 req'd)	4/c #16
Other meters	R&S #8946R (72 req'd)	R&S #8714R (1 req'd)	3/c #16



TYPICAL PLUG BOARD DETAIL
NO SCALE

SCHEDULE OF ELECTRICAL METERS (I)			
METER NO	STATION	ELEVATION	DIST FROM ℄
CS-1	0+15B	1720	0'-0"
CS-2	0+15B	1695	0'-0"
CS-3	0+15B	1670	0'-0"
CS-4	3+75B	1850	79'-0" R
CS-5		1850	57'-0" R
CS-6		1780	25'-0" R
CS-7		1760	25'-0" R
CS-8		1740	25'-0" R
CS-9		1780	0'-0"
CS-10		1760	0'-0"
CS-11		1740	0'-0"
CS-12		1780	25'-0" L
CS-13		1760	25'-0" L
CS-14		1740	25'-0" L
CS-15		1850	57'-0" L
CS-16	3+75B	1850	79'-0" L
SM-1-5	0.01 3B	1905	61'-2" R
SM-6-10	0.01 3B	1905	61'-2" L
SM-11	3+75B	1850	80'-0" R
SM-12		1850	56'-0" R
SM-13		1780	26'-0" R
SM-14		1760	26'-0" R
SM-15		1740	26'-0" R
SM-16		1780	0'-0"
SM-17		1760	0-0
SM-18		1740	0-0"
SM-19		1780	26'-0" L
SM-20		1760	26'-0" L
SM-21		1740	26'-0" L
SM 22		1850	56'-0" L
SM 23	3+75B	1850	80'-0" L
PP-1	0+15B	1750	87'-0" R
PP-2		1720	87'-0" R
PP-3		1690	87'-0" R
PP-4		1750	53'-0" R
PP-5		1720	53'-0" R
PP-6		1690	53'-0" R
PP-7		1730	0'-0"
PP-8		1705	0'-0"
PP-9		1680	0'-0"
PP-10		1750	53'-0" L
PP-11		1720	53'-0" L
PP-12		1690	53'-0" L
PP-13		1750	92'-0" L
PP-14		1720	92'-0" L
PP-15	0+15B	1690	92'-0" L
PP-16	3+75B	1780	0'-0"
PP-17	3+75B	1760	0'-0"
PP-18	3+75B	1740	0'-0"
JM-1	0+89B	17125	83'-0" R
JM-2		17125	71'-0" R
JM-3		17125	71'-6" R
JM-4		17125	60'-0" R
JM-5		16975	60'-0" L
JM-6		16975	71'-10" L
JM-7		16975	72'-5" L
JM-8	0+89B	16975	64'-3" L

Note: Elevations shown in schedule are approx. exact elevations to be determined by lift elevations.

SCHEDULE OF ELECTRICAL METERS (II)			
METER NO	STATION	ELEVATION	APPROX DIST FROM ℄
SS-1	0+61 A	213.0	88'-0" L
SS-2		195.0	89'-6" L
SS-3		180.0	90'-6" L
SS-4		165.0	103'-0" L
SS-5	0+13B	164.5	87'-0" R
SS-6			53'-0" R
SS-7			26'-6" R
SS-8			0-0"
SS-9			26'-6" L
SS-10			53'-0" L
SS-11			97'-0" L
SS-12		175.0	103'-0" L
SS-13		179.0	102'-0" L
SS-14		185.0	91'-0" L
SS-15		195.0	90'-0" L
SS-16		205.0	89'-0" L
SS-17	0+13B	215.0	88'-0" L
SS-18	3+73B	162.5	81'-6" R
SS-19		167.5	56'-6" R
SS-20		172.5	28'-6" R
SS-21		172.5	0'-0"
SS-22		172.5	28'-6" L
SS-23		165.5	56'-6" L
SS-24		165.5	81'-6" L
SS-25		175.0	81'-6" L
SS-26		185.0	81'-6" L
SS-27		195.0	81'-6" L
SS-28		196.0	80'-6" L
SS-29		205.0	64'-0" L
SS-30	3+73B	215.0	63'-0" L

CONTRACT NO. 55-133
RECORD DRAWING AS CONSTRUCTED
C. F. Kerry 18 FEB 64

LEGEND

- Carlson Type Stress Meter for Soils (SS)
- Carlson Type Strain Meter (SM)
- C Carlson Type Stress Meter for Concrete (C)
- P Carlson Type Pore Pressure Cell (PP)
- Piezometer
- Jointmeter

GALLERY RECESSES			
STATION		INSTRUMENTS	RECESS WIDTH
STA 0+30A	LAND WALL	[illegible]	8'
STA 0+15B	LAND WALL	[illegible]	8'
	RIVER WALL	[illegible]	8'
STA 1+80B	LAND WALL	[illegible]	8'
STA 3+70B	LAND WALL	[illegible]	8'
	RIVER WALL	[illegible]	8'
STA 5+00B	LAND WALL	[illegible]	8'

THIS DRAWING FORMS A PART OF MODIFICATION NO 20
CONTRACT NO DA03050CIVENG-65-103

NOTES:
1. FOR LOCATION OF SECTIONS, SEE DWG. 720
2. FOR DETAIL "A", SEE DWG. 723
3. FOR DETAIL "B", SEE DWG. 723
4. FOR PIEZOMETER DETAILS, SEE DWG. 722
5. PIEZOMETER SHALL BE PLACED TO CLEAR ALL INSTRUMENTATION AND REINFORCING

SYMBOL	DATE	DESCRIPTION	BY
③		Add joint meters; delete and revise location of strain & stress meters, added meter schedule, and general revisions. Mod No. 20	JCB
②		Chg 500 watt heater to 100 watt; Mod No. 1	
①	1-13-65	Revised instrument numbers, added plug board detail, Amend. 3	

US ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

US ARMY ENGINEER DISTRICT, LITTLE ROCK
OFFICE OF THE DISTRICT ENGINEER
LITTLE ROCK, ARKANSAS

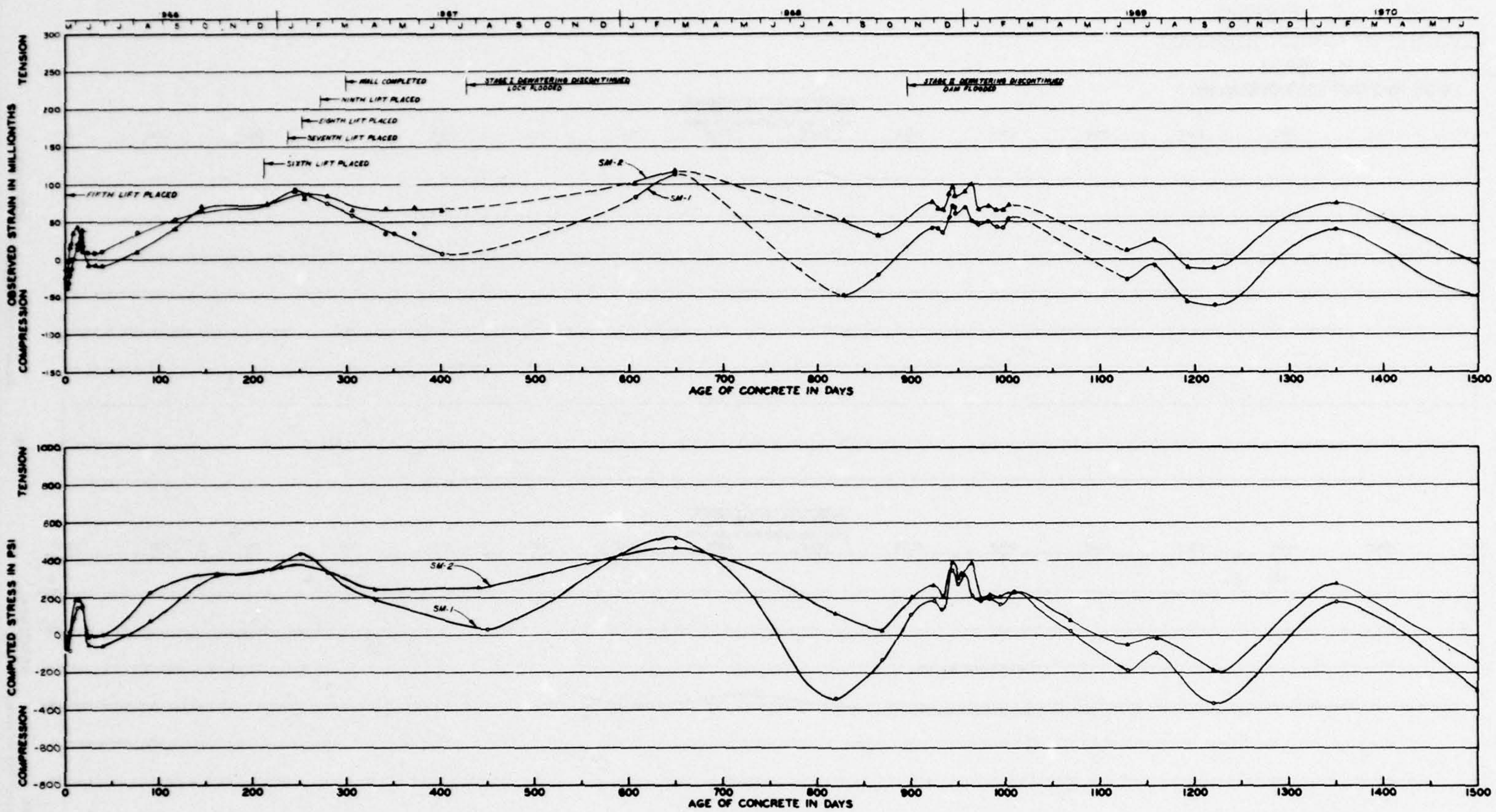
ARKANSAS RIVER AND TRIBUTARIES — ARKANSAS RIVER, ARKANSAS

LOCK AND DAM NO. 5
NAVIGATION LOCK
ENGINEERING MEASUREMENT DEVICES
DETAILS II

CHIEF, DESIGN BRANCH
CHIEF, ENGRG DIVISION, FORT WORTH DISTRICT OFFICE
APPROVED: E. Z. R.
CHIEF, ENGINEERING DIVISION
PREPARED UNDER THE DIRECTION OF CHARLES D. MAYNARD, COL., C.E., DISTRICT ENGINEER

DATE: NOVEMBER 1964
SCALE: AS SHOWN
DRAWING NUMBER: 8258-56/721

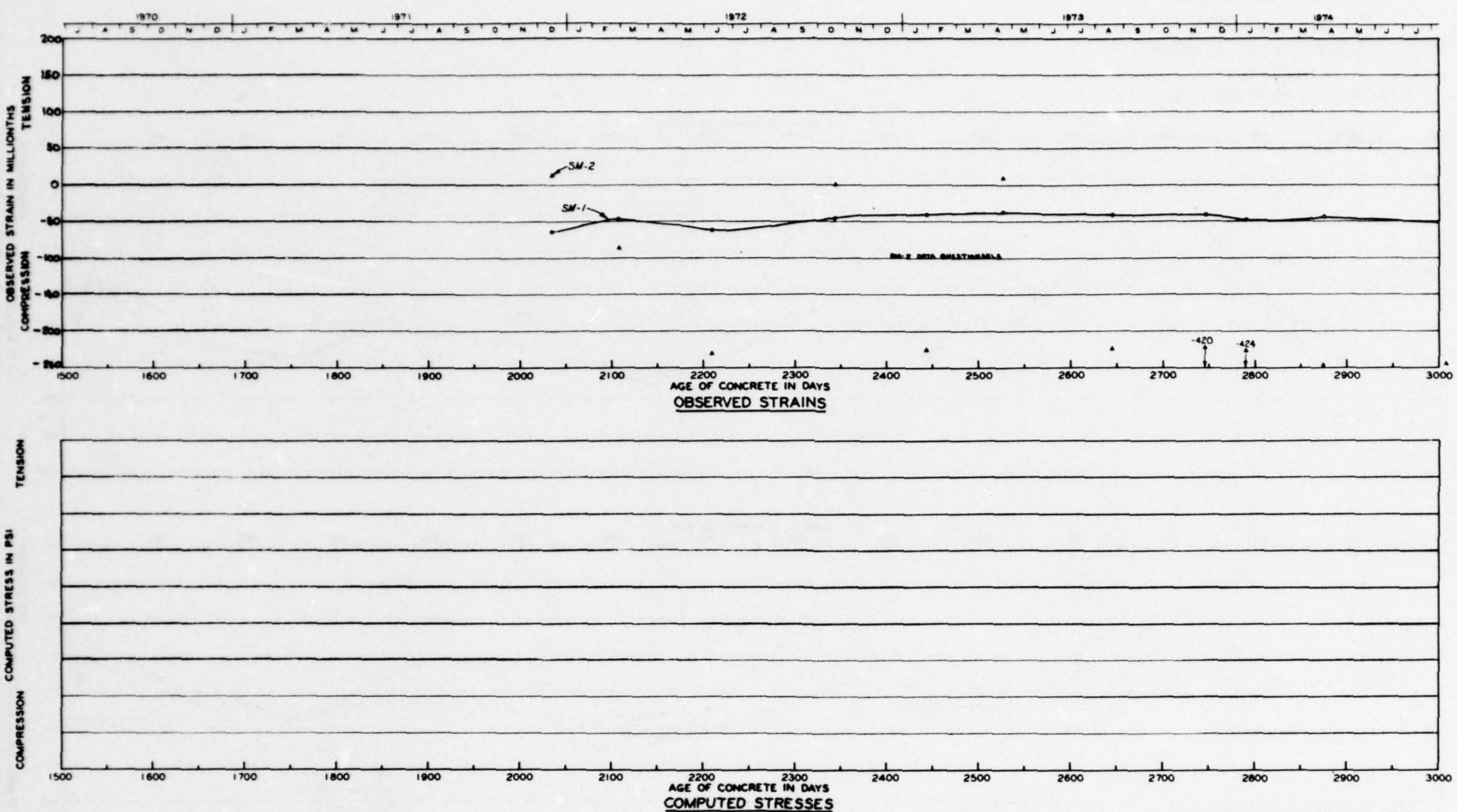
PLATE 2



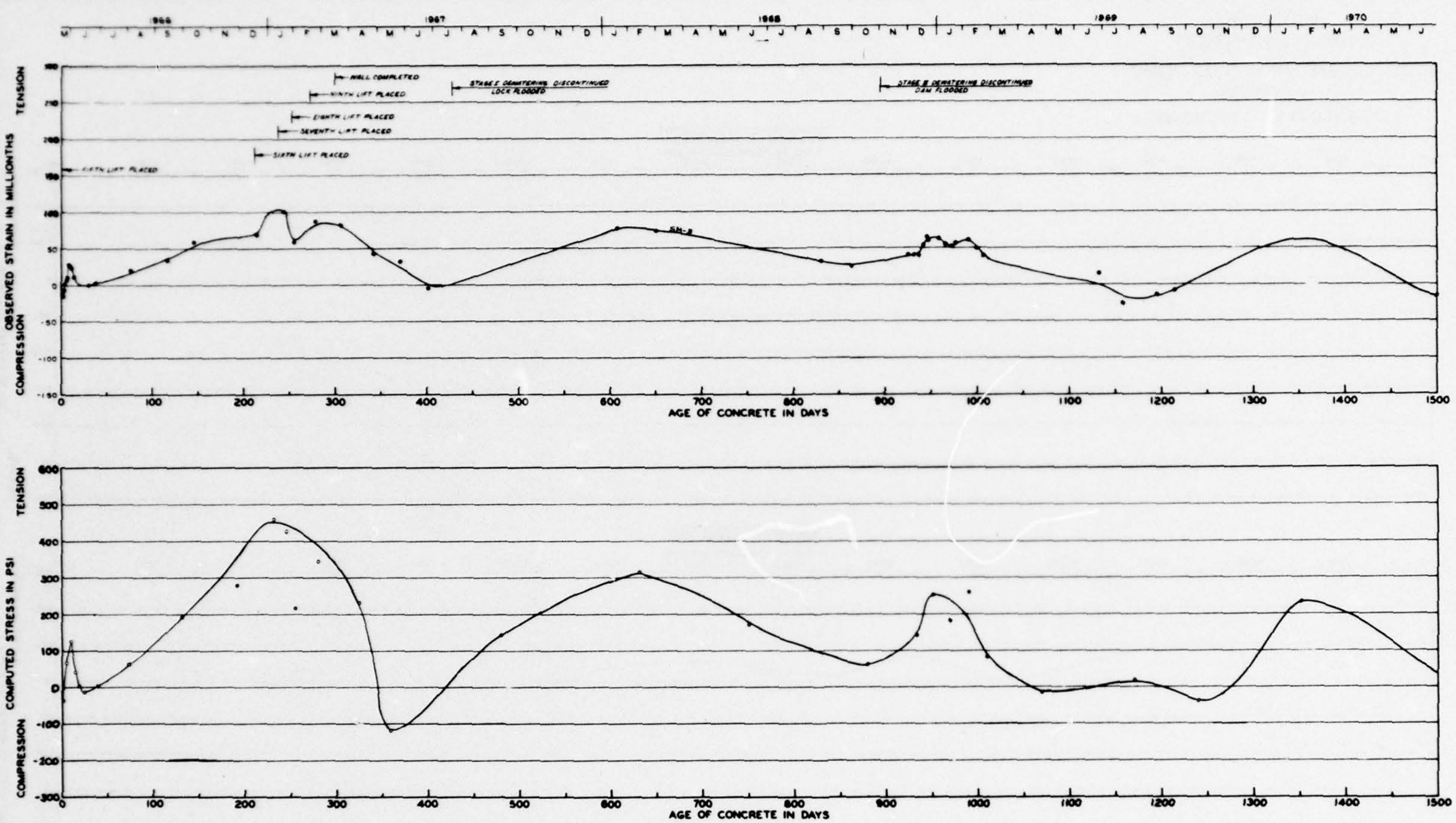
ARKANSAS LOCK AND DAM NO. 5
MONOLITH 11
CONCRETE STRAIN METER DATA
OBSERVED STRAINS
METERS SM-1 AND SM-2

PLATE 3

PLATE 4

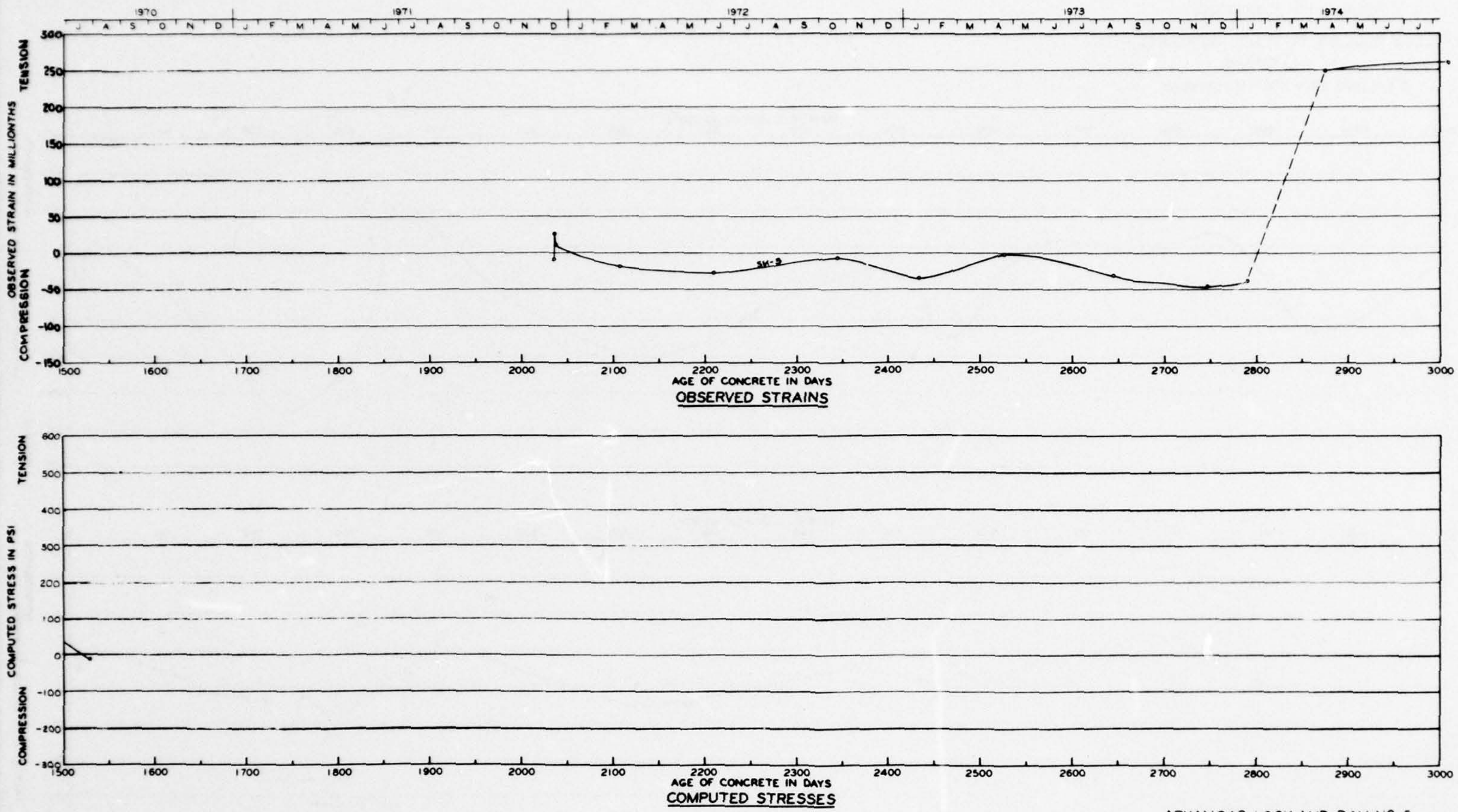


ARKANSAS LOCK AND DAM NO. 5
MONOLITH 11
CONCRETE STRAIN METER DATA
OBSERVED STRAINS
METERS SM-1 AND SM-2



ARKANSAS LOCK AND DAM NO. 5
MONOLITH 11
CONCRETE STRAIN METER DATA
OBSERVED STRAINS
METER SM-3

PLATE 5



ARKANSAS LOCK AND DAM NO. 5
MONOLITH 11
CONCRETE STRAIN METER DATA
OBSERVED STRAINS
METER SM-3

PLATE 6

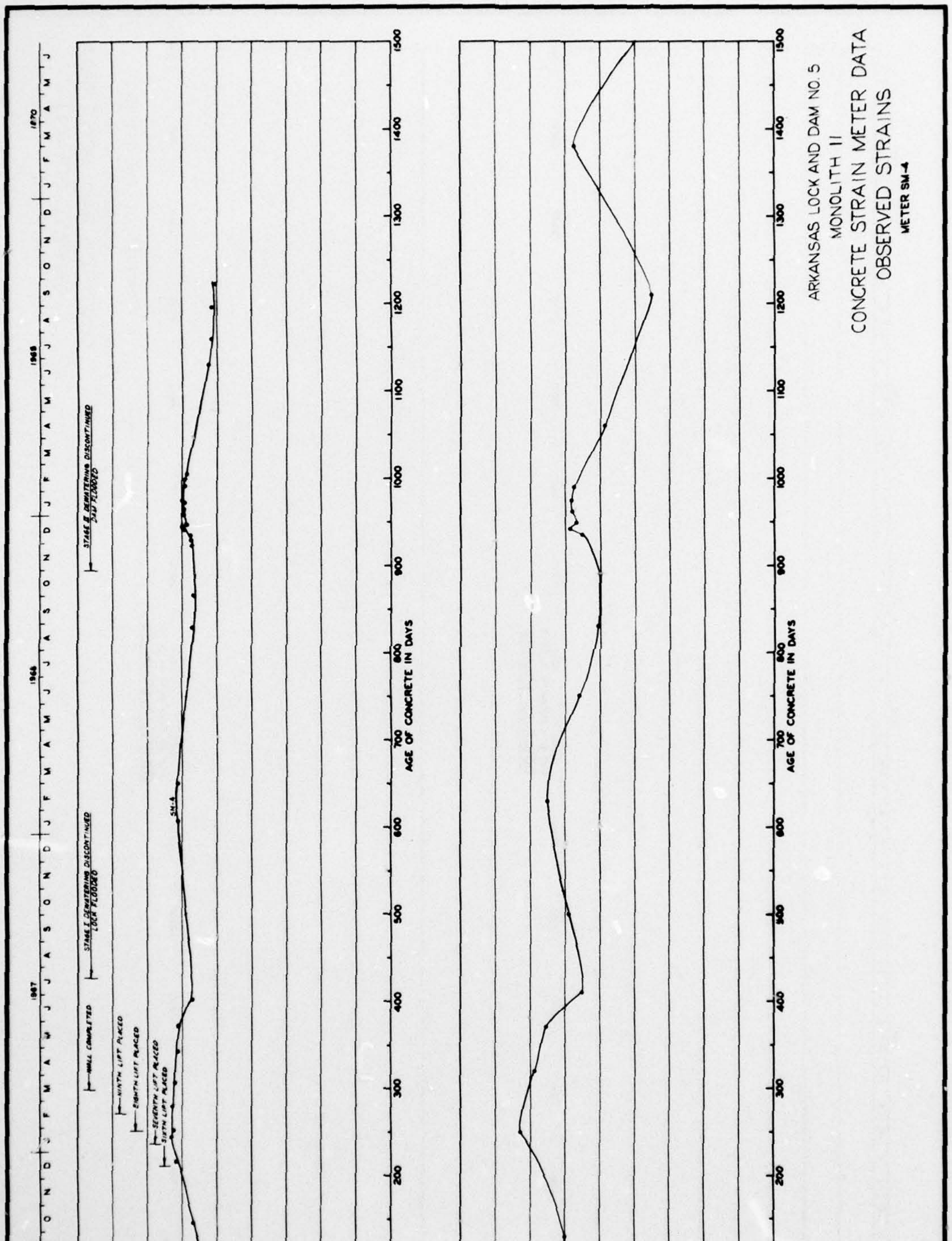
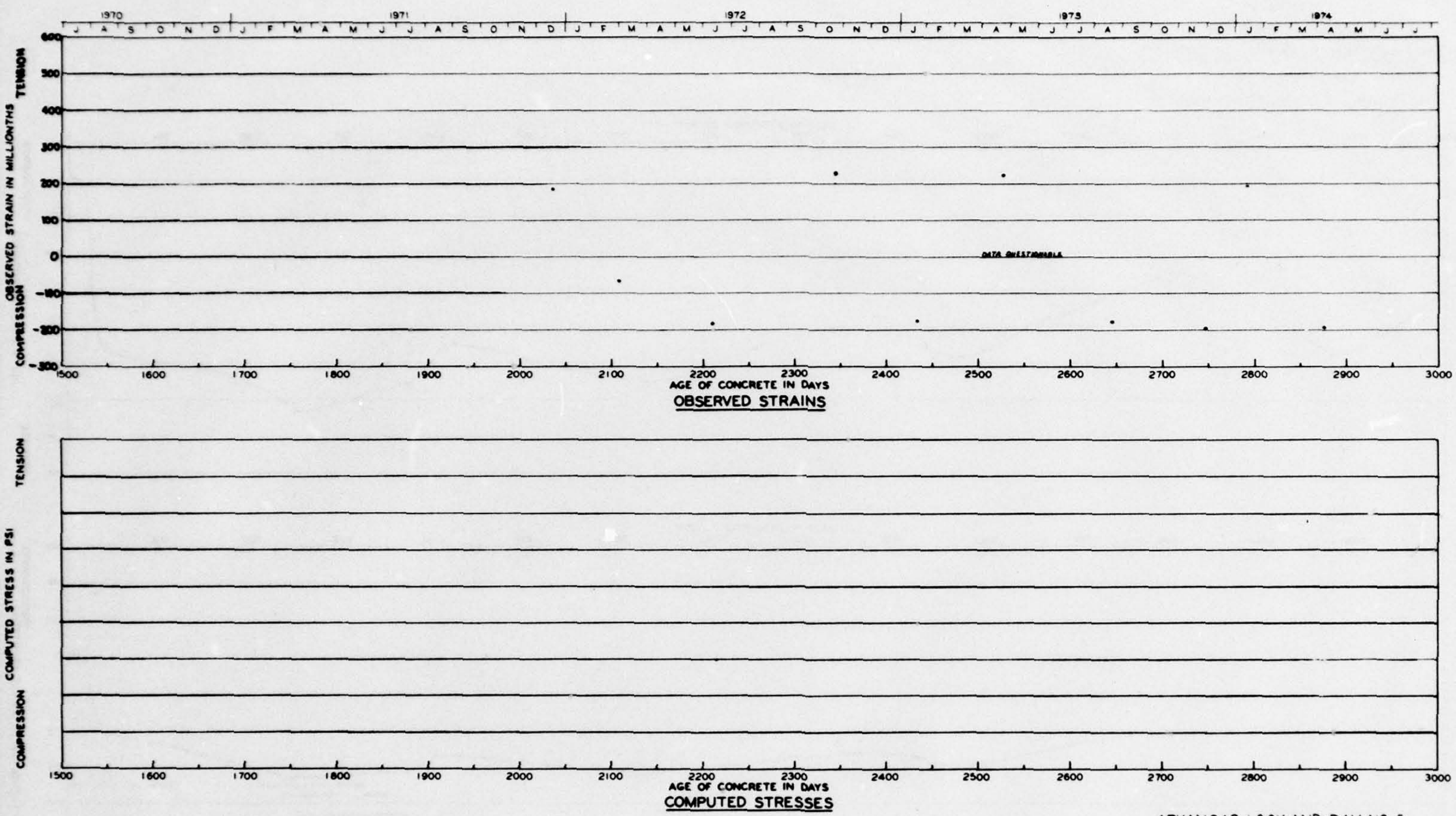
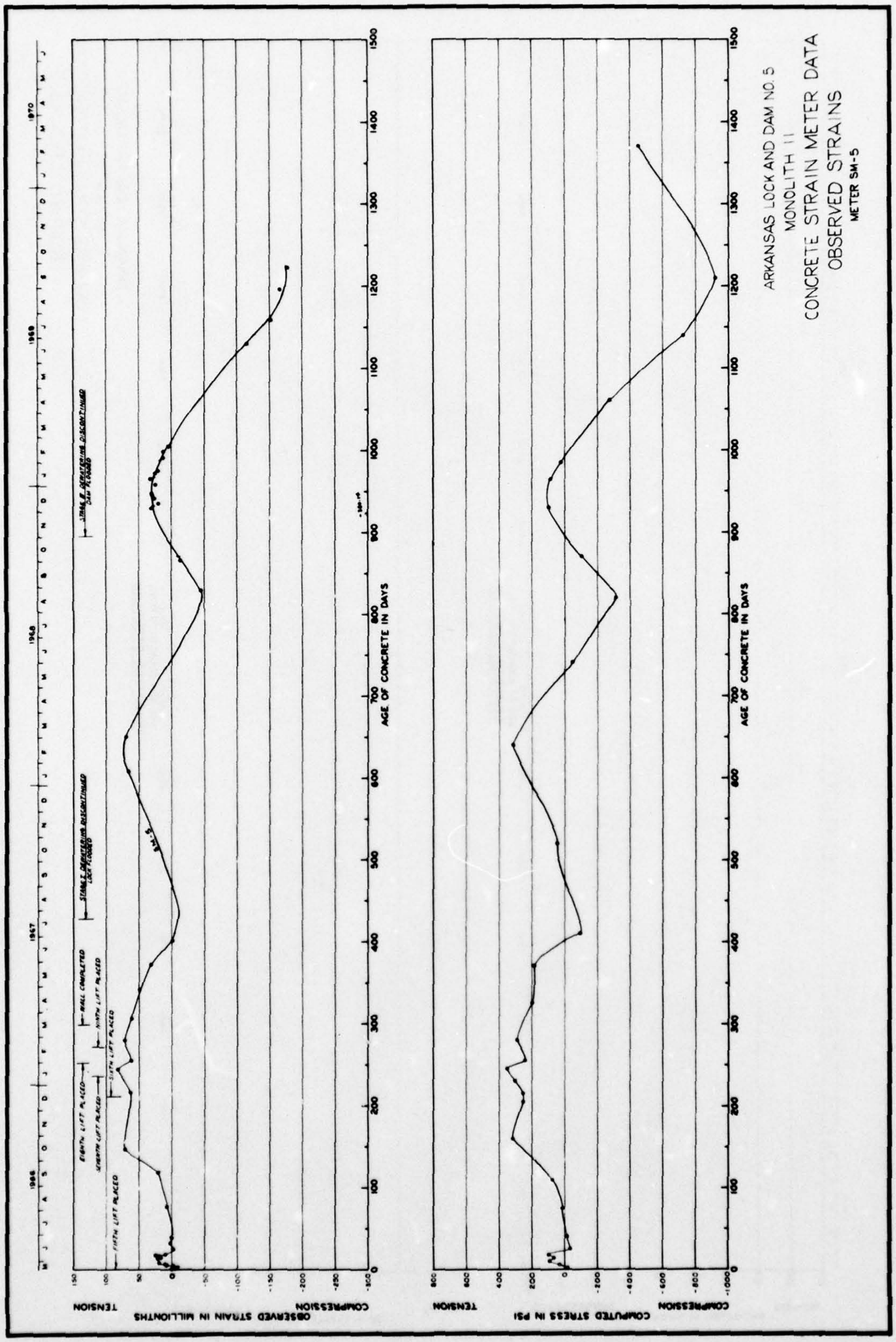

ARKANSAS LOCK AND DAM NO. 5
MONOLITH 11
CONCRETE STRAIN METER DATA
OBSERVED STRAINS
METER SM-4
OBSERVED STRAIN IN MILLIONTHS
TENSION
COMPRESSION
COMPUTED STRESS IN PSI
AGE OF CONCRETE IN DAYS
FIFTH LIFT PLACED
SIXTH LIFT PLACED
SEVENTH LIFT PLACED
EIGHTH LIFT PLACED
NINTH LIFT PLACED
WALL COMPLETED
STAGE I DEWATERING DISCONTINUED
LOCK FLOODED
STAGE II DEWATERING DISCONTINUED
DAM FLOODED
SM-4

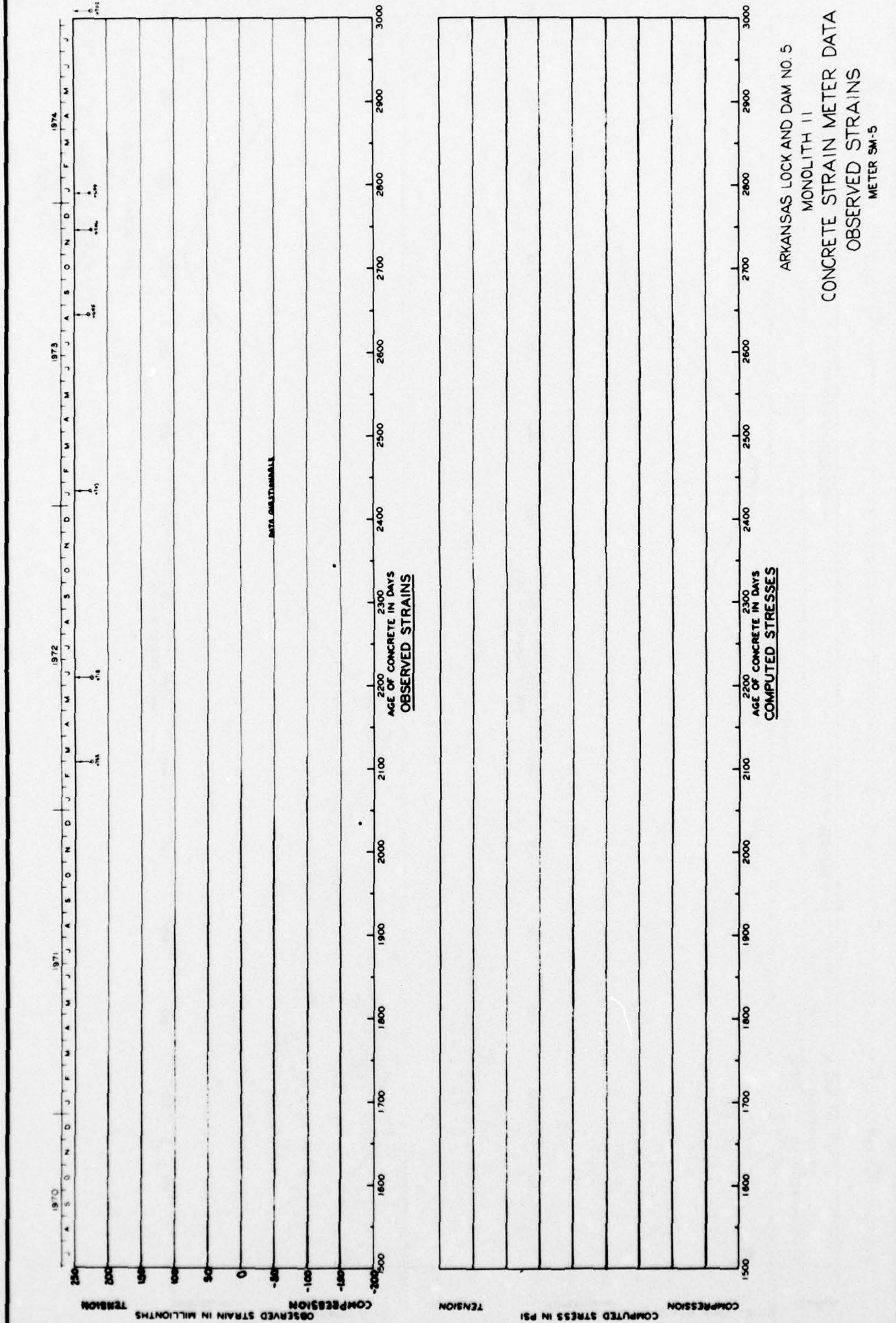
PLATE 7



ARKANSAS LOCK AND DAM NO. 5
MONOLITH 11
CONCRETE STRAIN METER DATA
OBSERVED STRAINS
METER SM-4

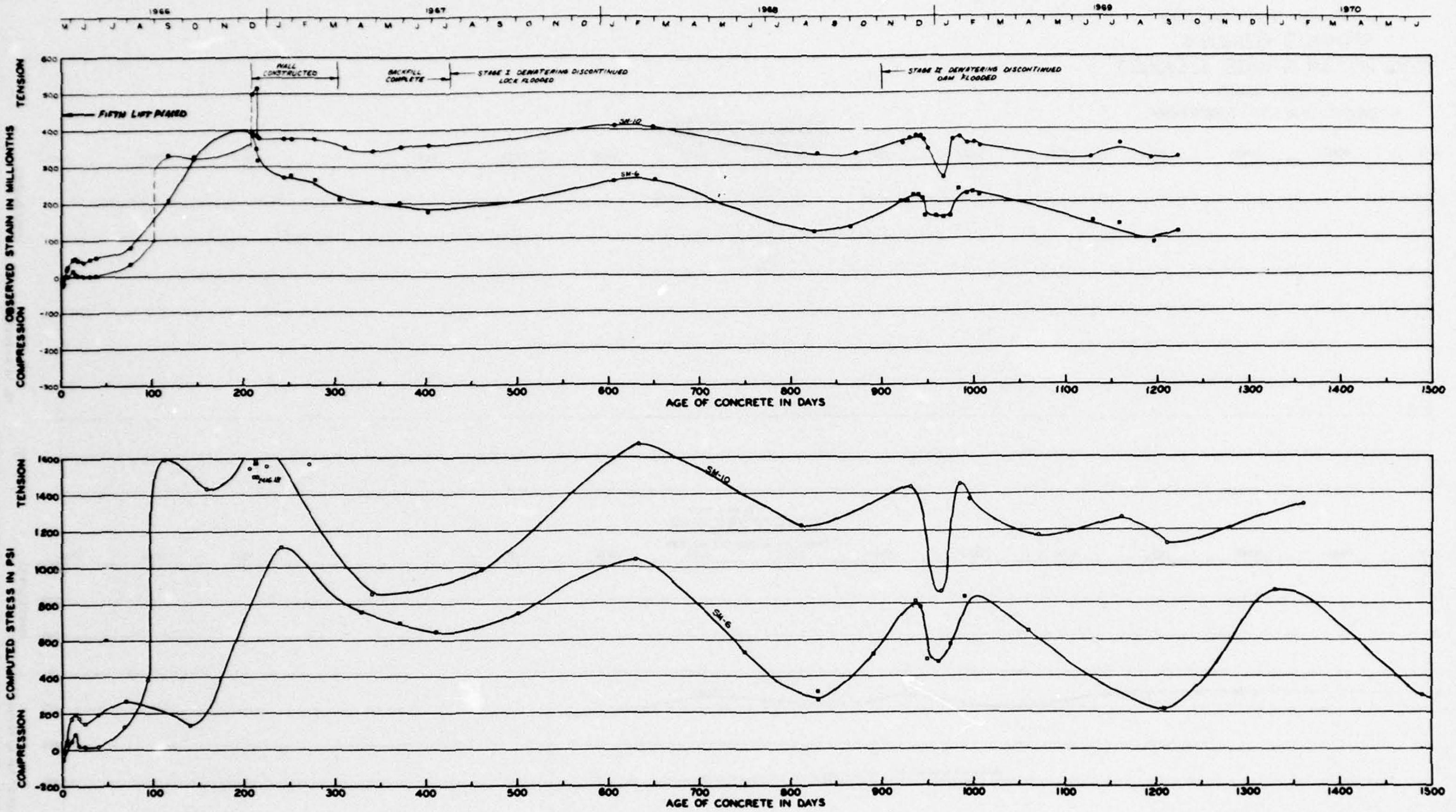
PLATE 8


ARKANSAS LOCK AND DAM NO. 5
MONOLITH 11
CONCRETE STRAIN METER DATA
OBSERVED STRAINS
METER SM-5
OBSERVED STRAIN IN MILLIONTHS
TENSION
COMPRESSION
COMPUTED STRESS IN PSI
AGE OF CONCRETE IN DAYS
1966
1967
1968
1969
1970
SM-5
FIFTH LIFT PLACED
SIXTH LIFT PLACED
SEVENTH LIFT PLACED
EIGHTH LIFT PLACED
NINTH LIFT PLACED
WALL COMPLETED

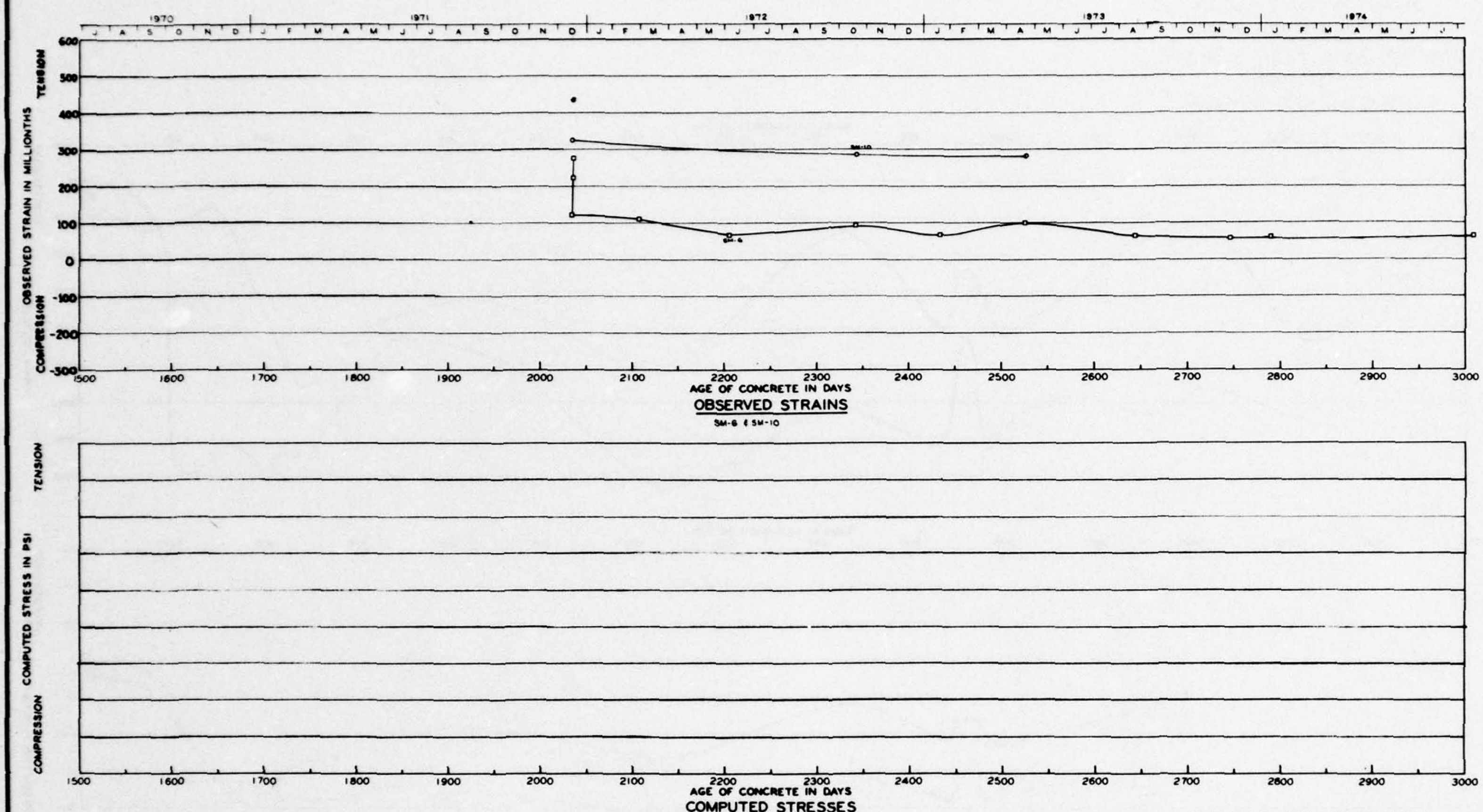


ARKANSAS LOCK AND DAM NO. 5
MONOLITH 11
CONCRETE STRAIN METER DATA
OBSERVED STRAINS
METER SM-5
OBSERVED STRAIN IN MILLIONTHS
TENSION
COMPRESSION
AGE OF CONCRETE IN DAYS
OBSERVED STRAINS
COMPUTED STRESS IN PSI
COMPUTED STRESSES
1970
1971
1972
1973
1974

PLATE 10

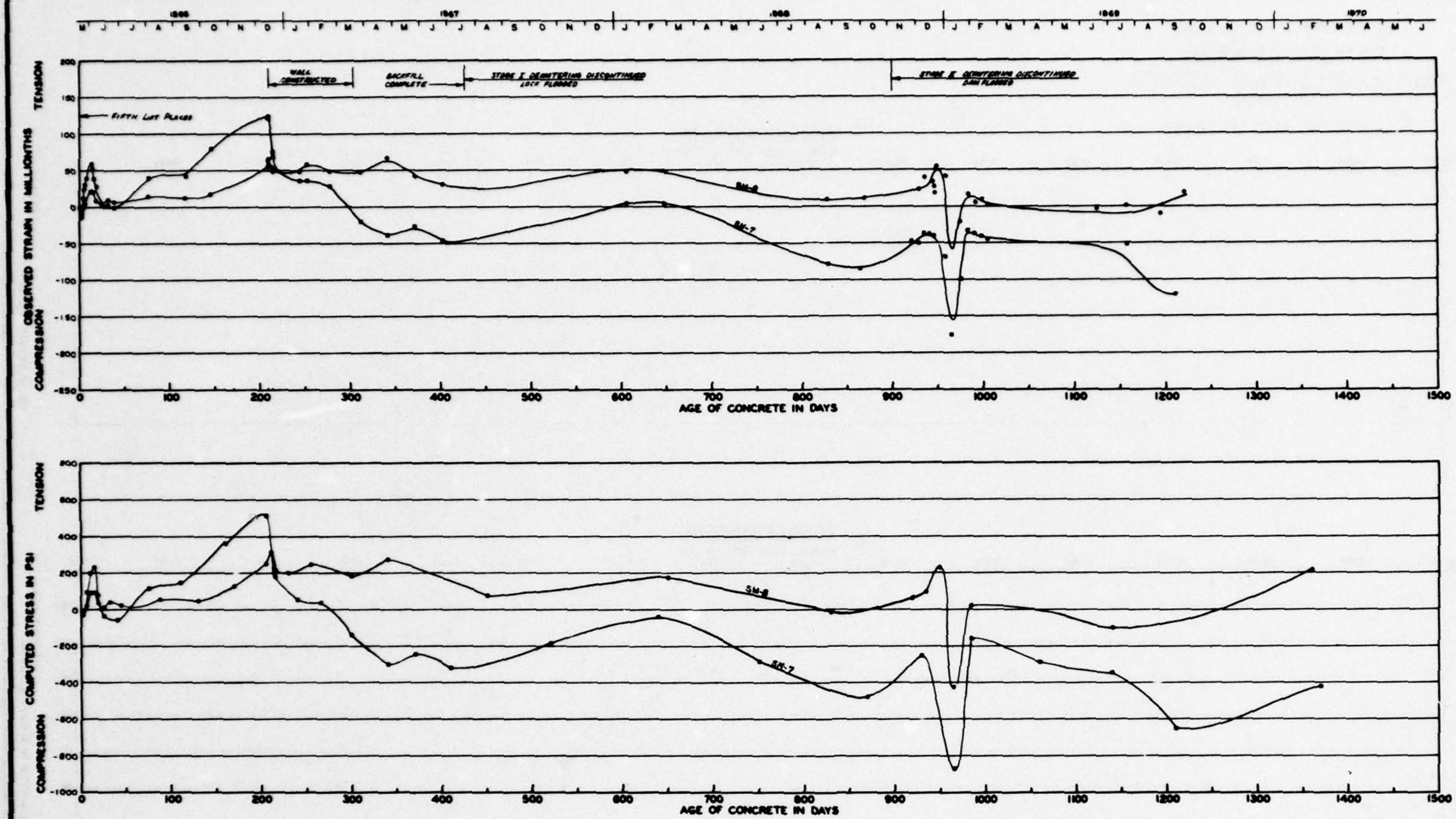


ARKANSAS LOCK AND DAM NO. 5
MONOLITH 11
CONCRETE STRAIN METER DATA
OBSERVED STRAINS
METERS SM-6 AND SM-10



ARKANSAS LOCK AND DAM NO. 5
MONOLITH 11
CONCRETE STRAIN METER DATA
OBSERVED STRAINS
METERS SM-6 AND SM-10

PLATE 12



ARKANSAS LOCK AND DAM NO. 5
MONOLITH 11
CONCRETE STRAIN METER DATA
OBSERVED STRAINS
METERS SM-7 AND SM-8

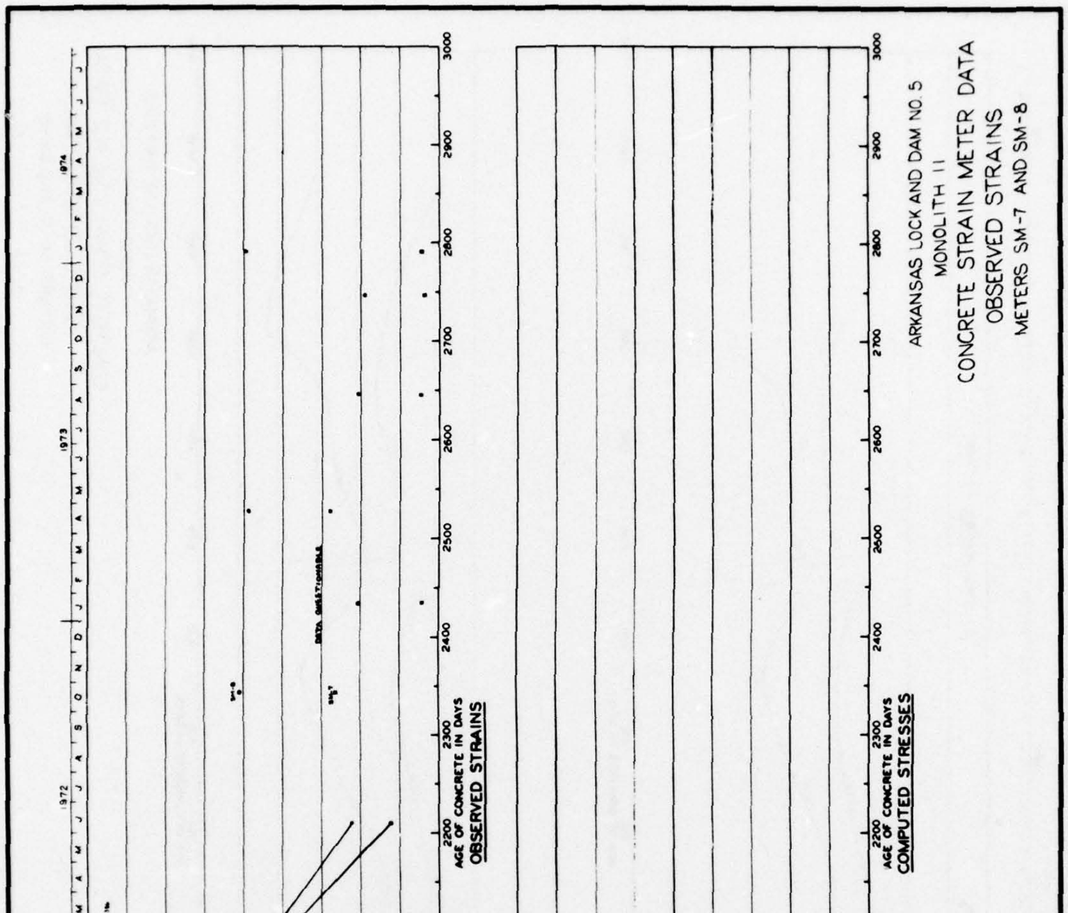
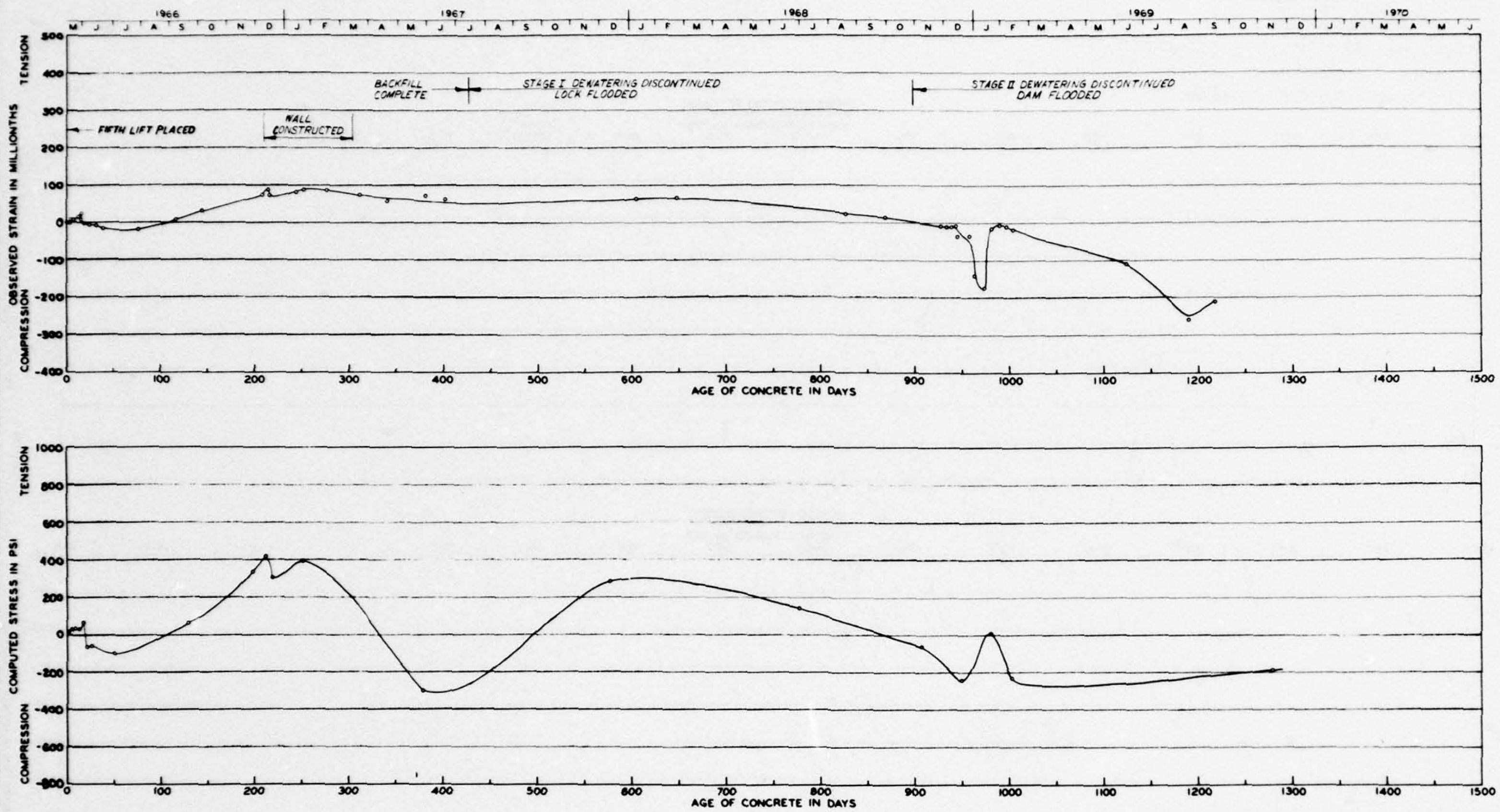
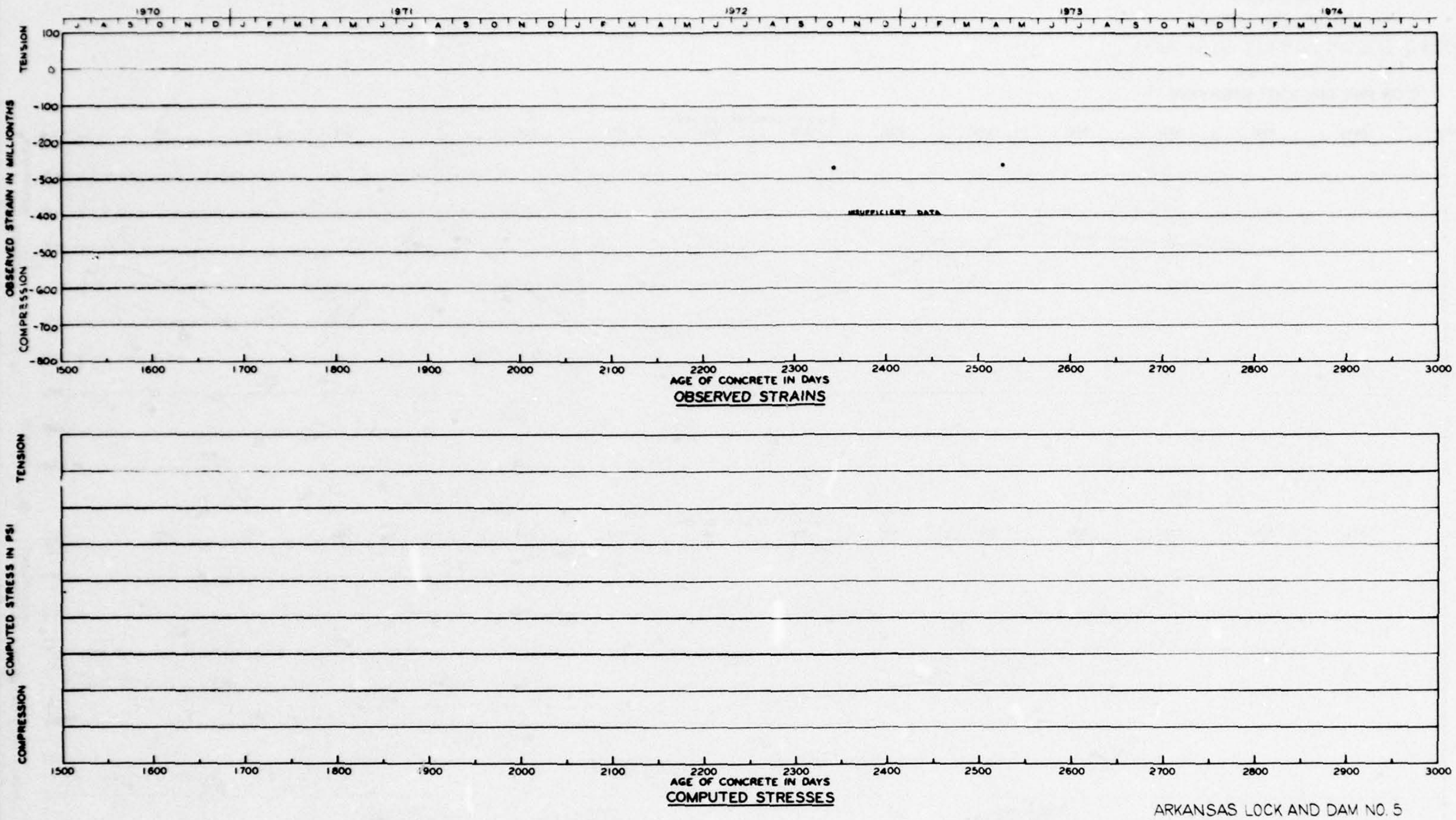

ARKANSAS LOCK AND DAM NO. 5
MONOLITH 11
CONCRETE STRAIN METER DATA
OBSERVED STRAINS
METERS SM-7 AND SM-8
OBSERVED STRAIN IN MILLIONTHS
TENSION
COMPRESSION
AGE OF CONCRETE IN DAYS
OBSERVED STRAINS
DATA QUESTIONABLE
COMPUTED STRESS IN PSI
AGE OF CONCRETE IN DAYS
COMPUTED STRESSES

PLATE 14

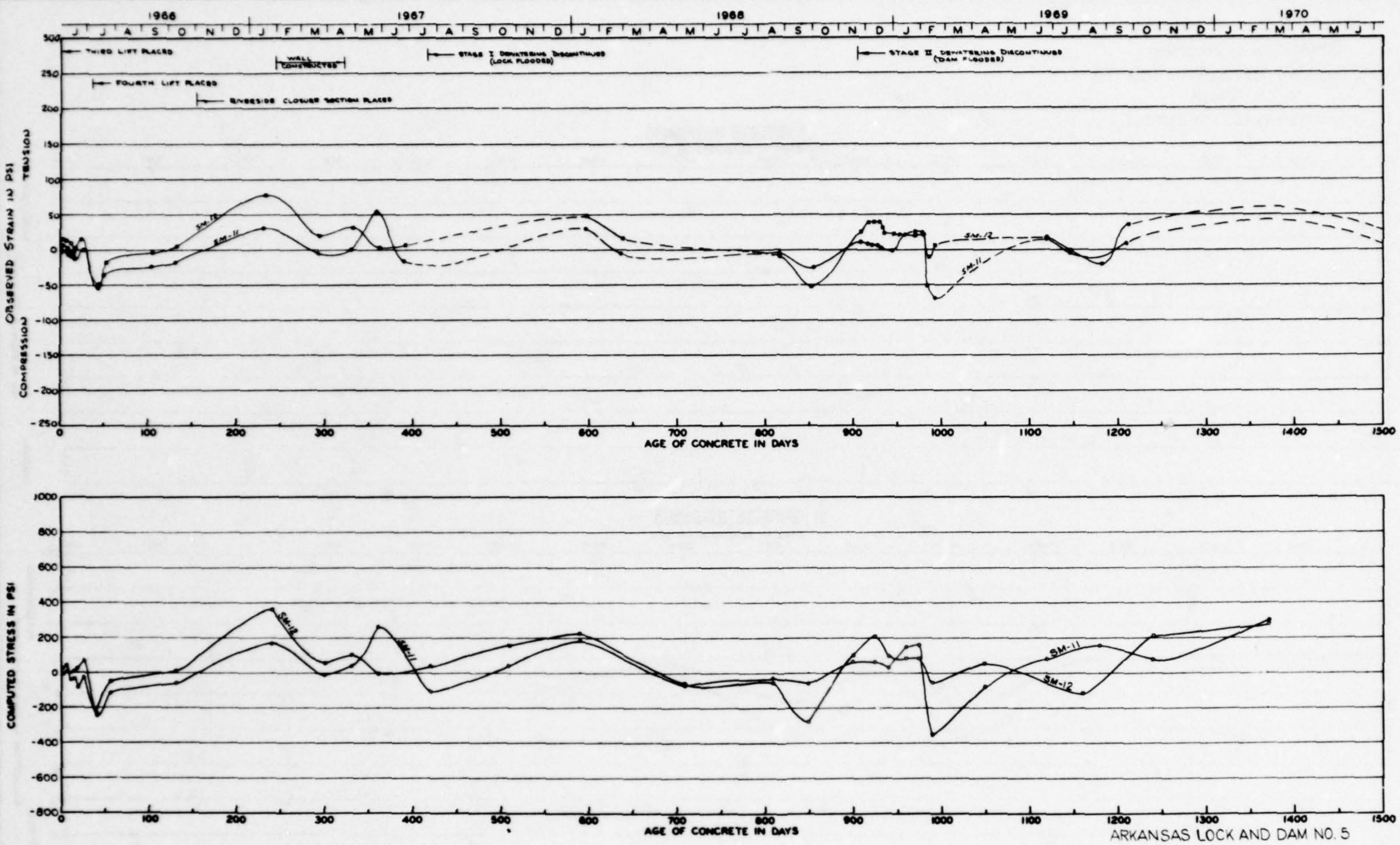


ARKANSAS LOCK AND DAM NO. 5
MONOLITH 11
CONCRETE STRAIN METER DATA
OBSERVED STRAINS
METER SM-9

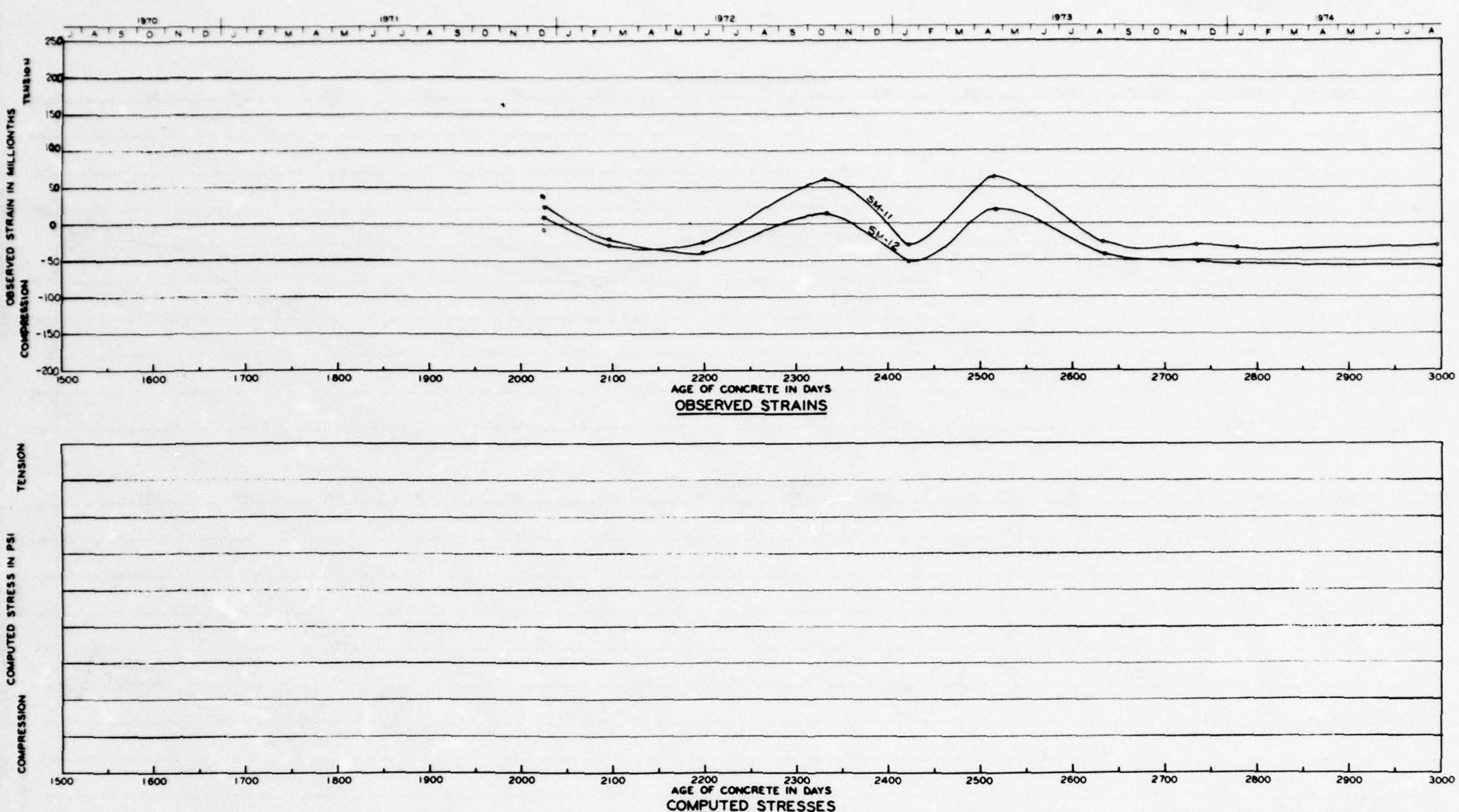


ARKANSAS LOCK AND DAM NO. 5
MONOLITH 11
CONCRETE STRAIN METER DATA
OBSERVED STRAINS
METER SM-9

PLATE 16



ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
CONCRETE STRAIN METER DATA
OBSERVED STRAINS
METERS SM-11 AND SM-12



ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
CONCRETE STRAIN METER DATA
OBSERVED STRAINS
METERS SM-11 AND SM-12

PLATE 18

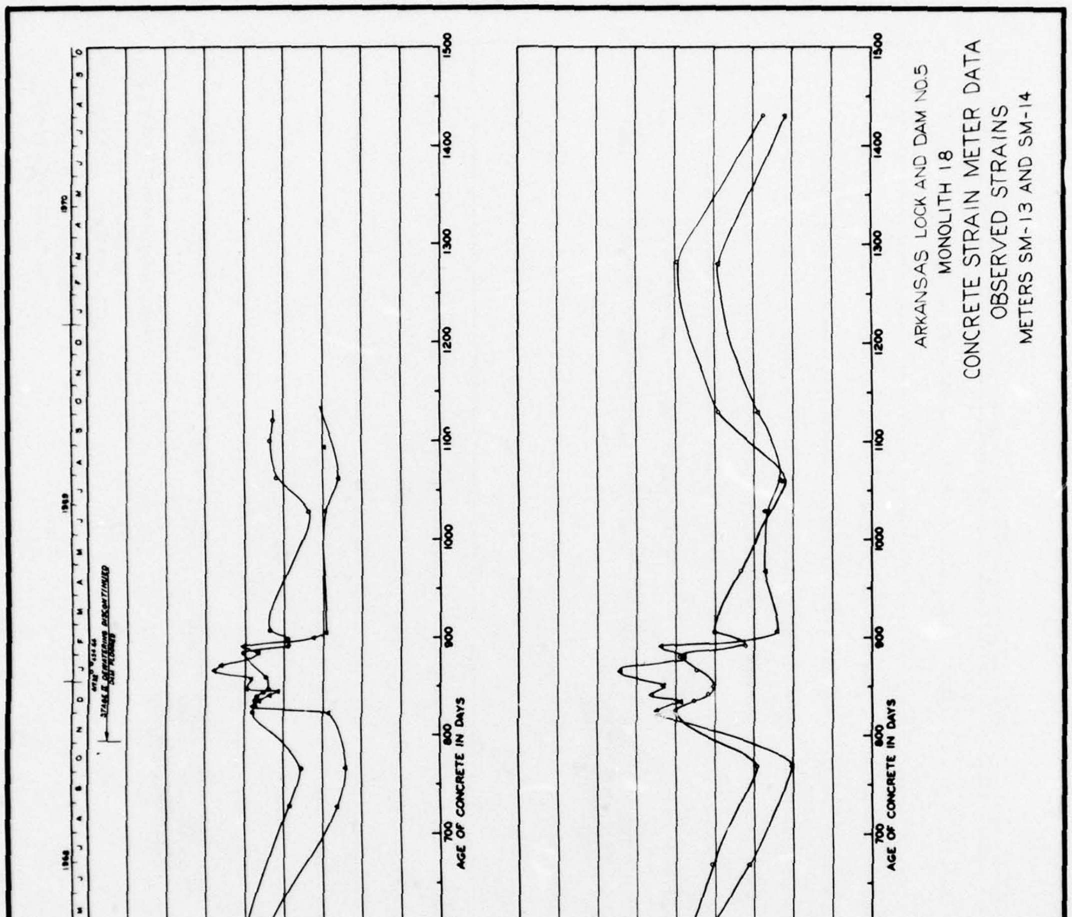

ARKANSAS LOCK AND DAM NO.5
MONOLITH 18
CONCRETE STRAIN METER DATA
OBSERVED STRAINS
METERS SM-13 AND SM-14
OBSERVED STRAIN IN MILLIONTHS
COMPUTED STRESS IN PSI
TENSION
COMPRESSION
AGE OF CONCRETE IN DAYS
CLOSURE SECTION PLACED
WALL CONSTRUCTED
SM-13
SM-14

PLATE 19

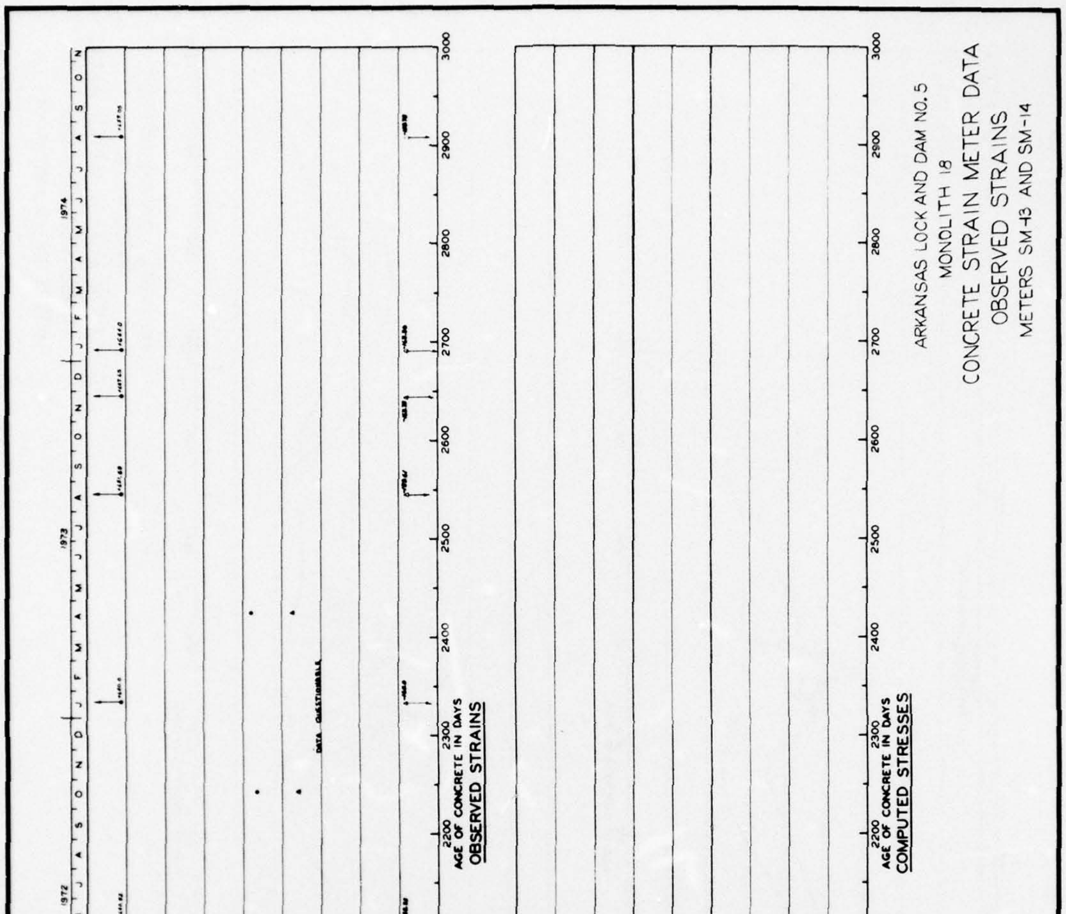
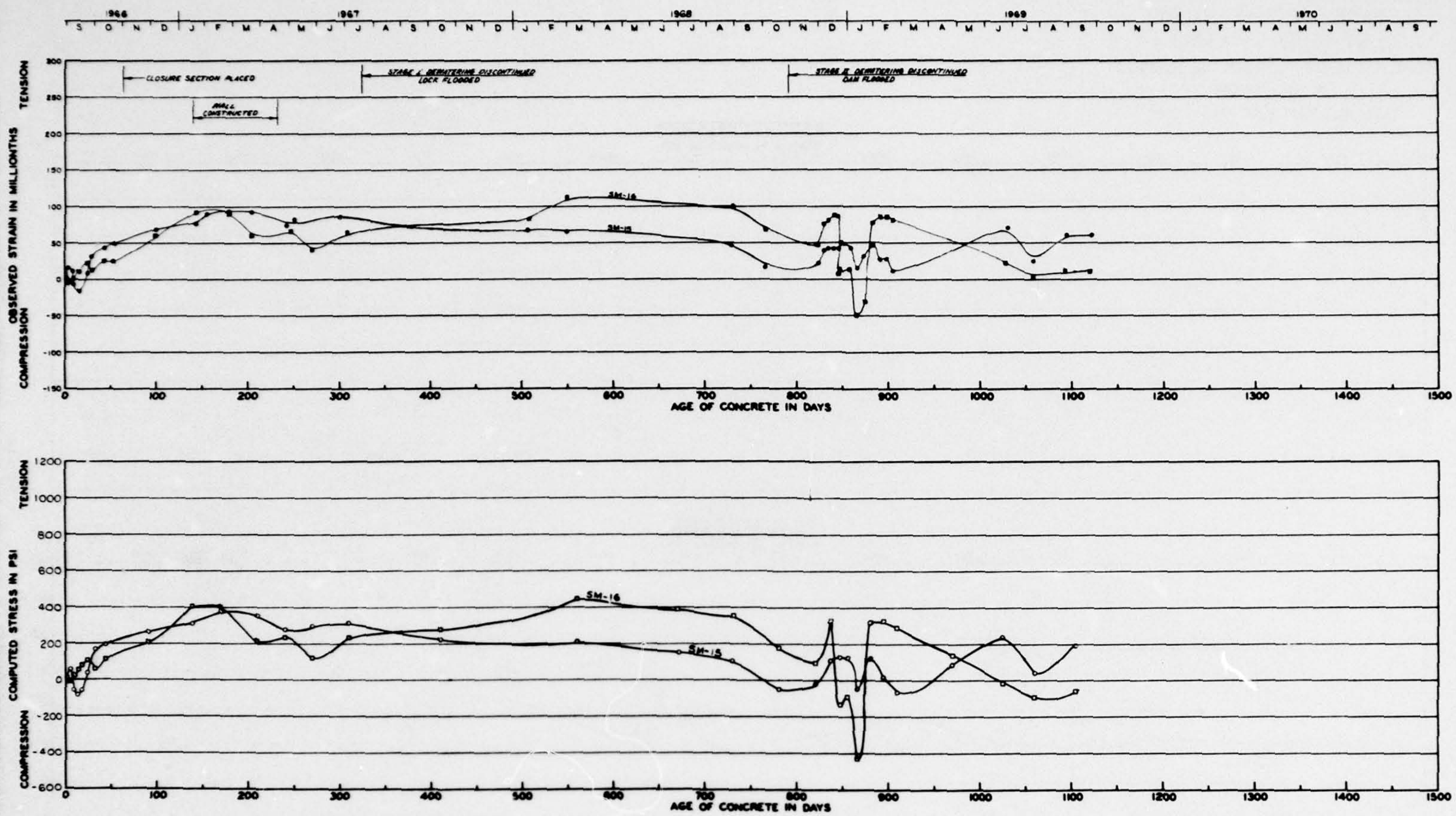
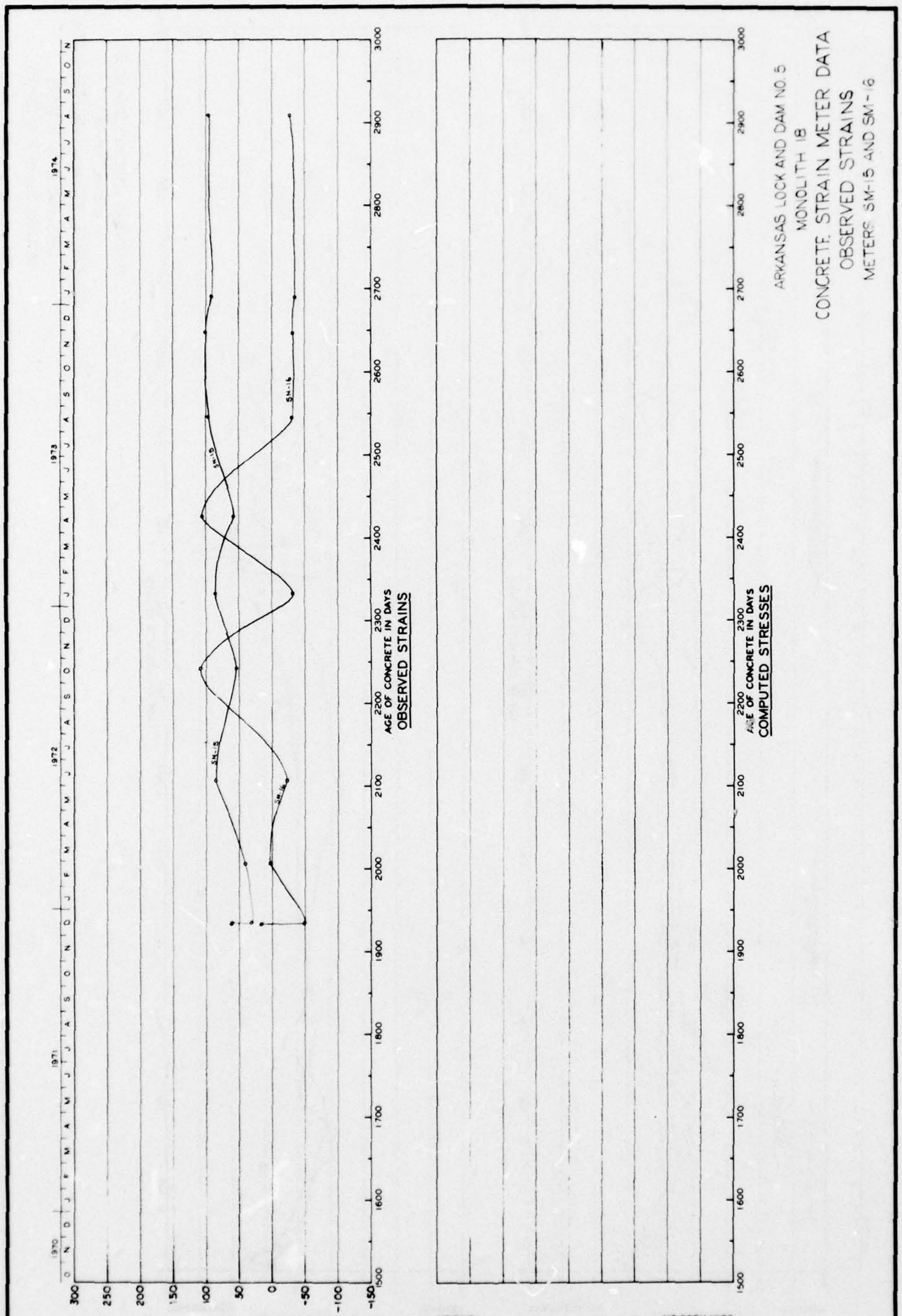

ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
CONCRETE STRAIN METER DATA
OBSERVED STRAINS
METERS SM-13 AND SM-14
OBSERVED STRAIN IN MILLIONTHS
AGE OF CONCRETE IN DAYS
OBSERVED STRAINS
DATA QUESTIONABLE
COMPUTED STRESS IN PSI
TENSION
COMPRESSION
AGE OF CONCRETE IN DAYS
COMPUTED STRESSES
1970
1971
1972
1973
1974

PLATE 20

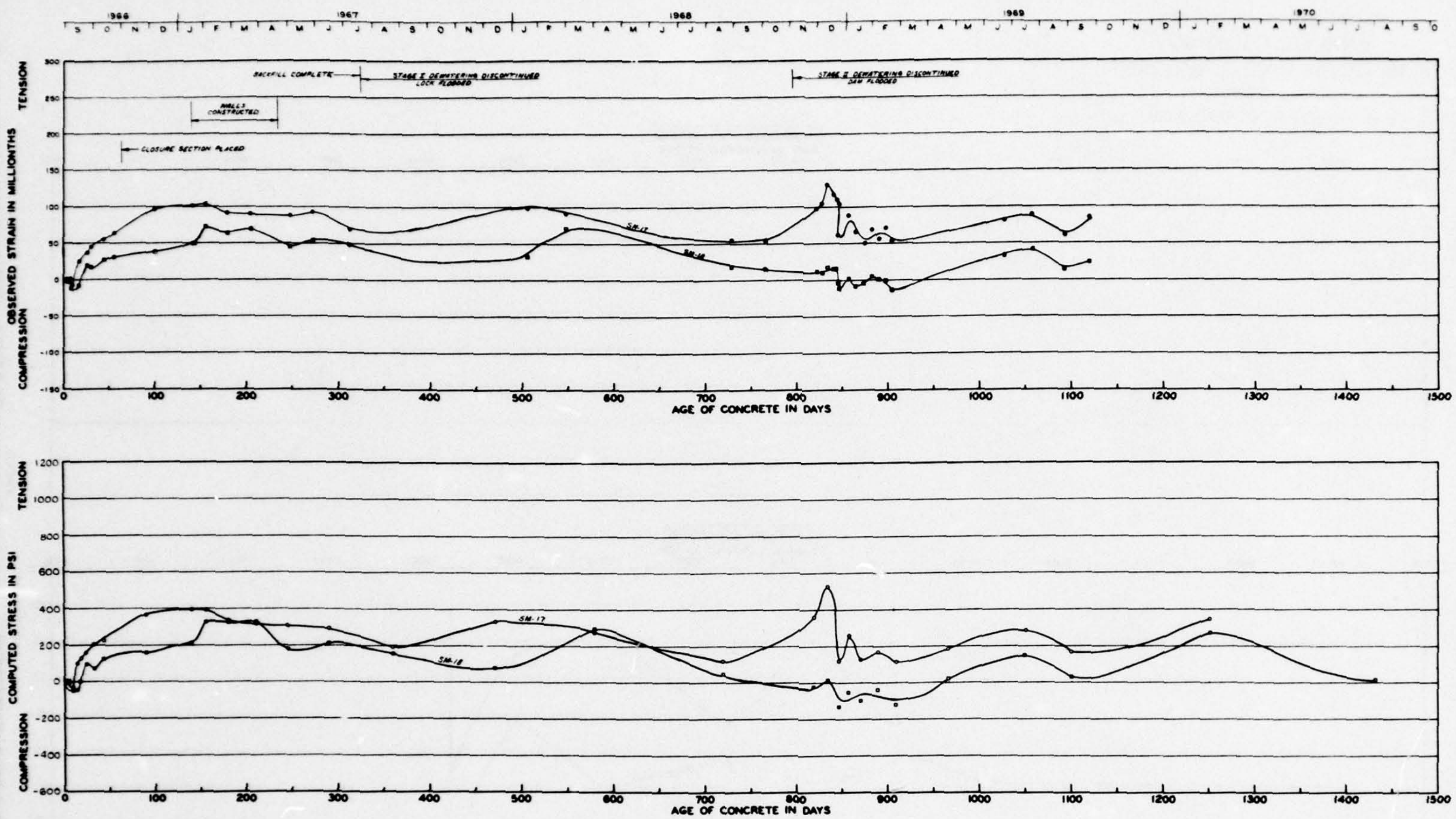


ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
CONCRETE STRAIN METER DATA
OBSERVED STRAINS
METERS SM-15 AND SM-16

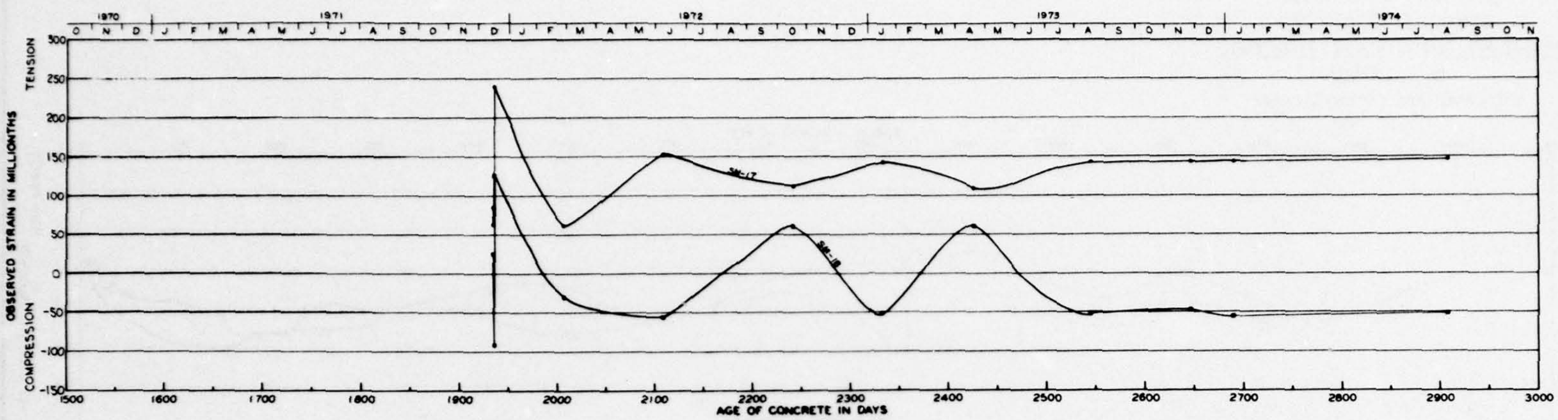


ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
CONCRETE STRAIN METER DATA
OBSERVED STRAINS
METERS SM-15 AND SM-16
OBSERVED STRAIN IN MILLIONTHS
AGE OF CONCRETE IN DAYS
OBSERVED STRAINS
SM-15
SM-16
COMPUTED STRESS IN PSI
TENSION
COMPRESSION
AGE OF CONCRETE IN DAYS
COMPUTED STRESSES
1970
1971
1972
1973
1974

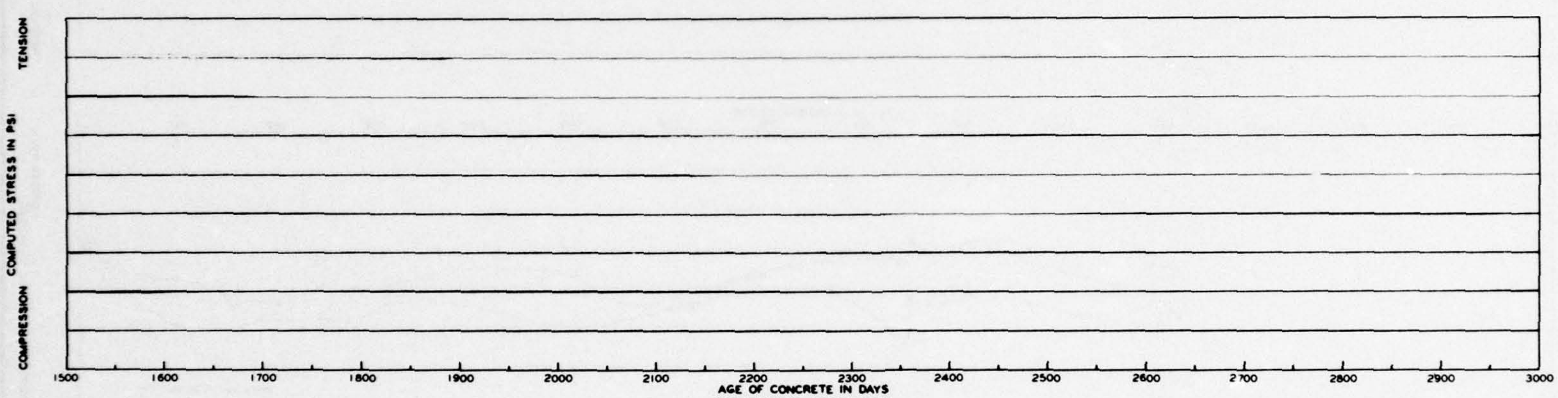
PLATE 22



ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
CONCRETE STRAIN METER DATA
OBSERVED STRAINS
METERS SM-17 AND SM-18



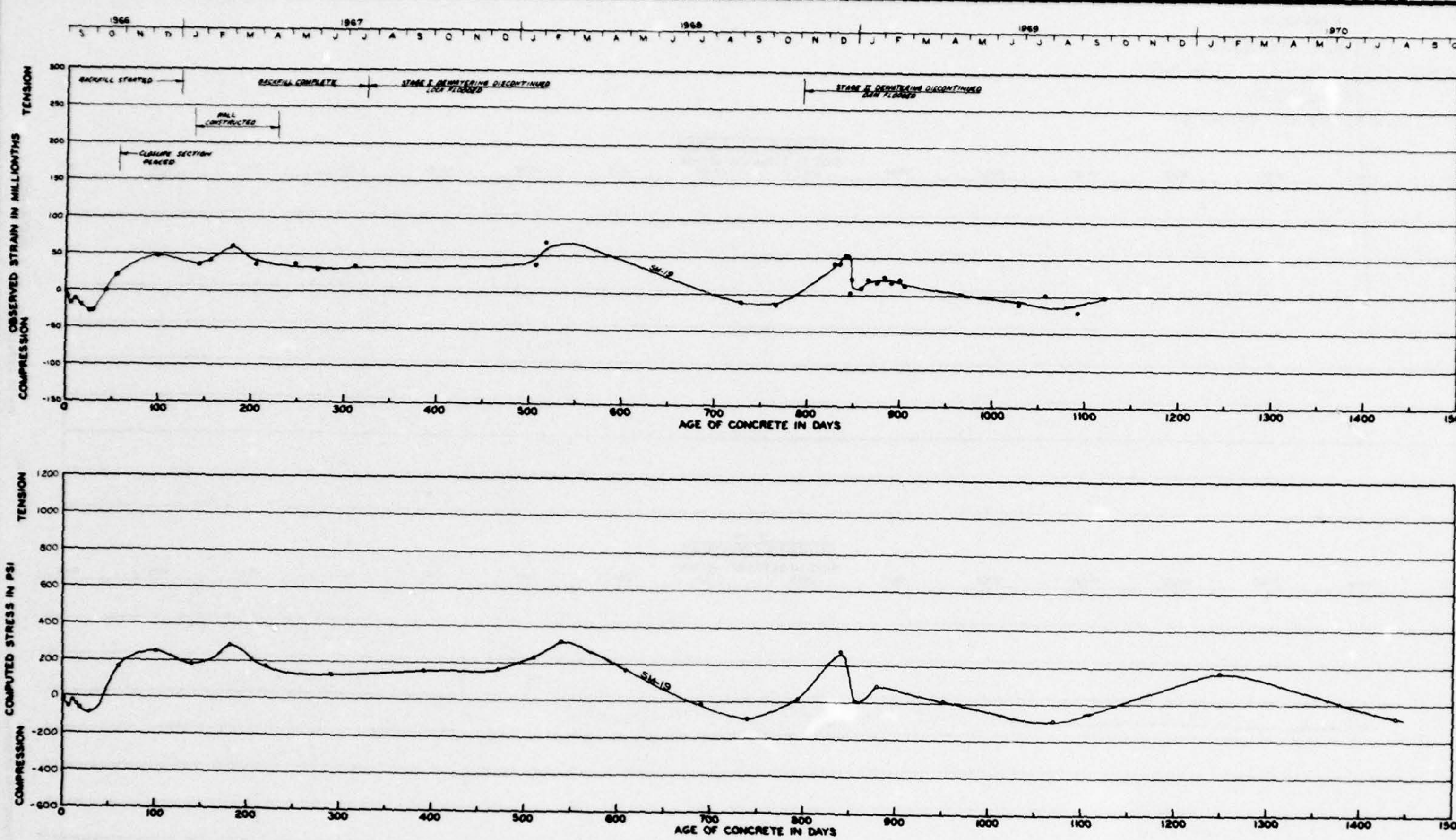
OBSERVED STRAINS



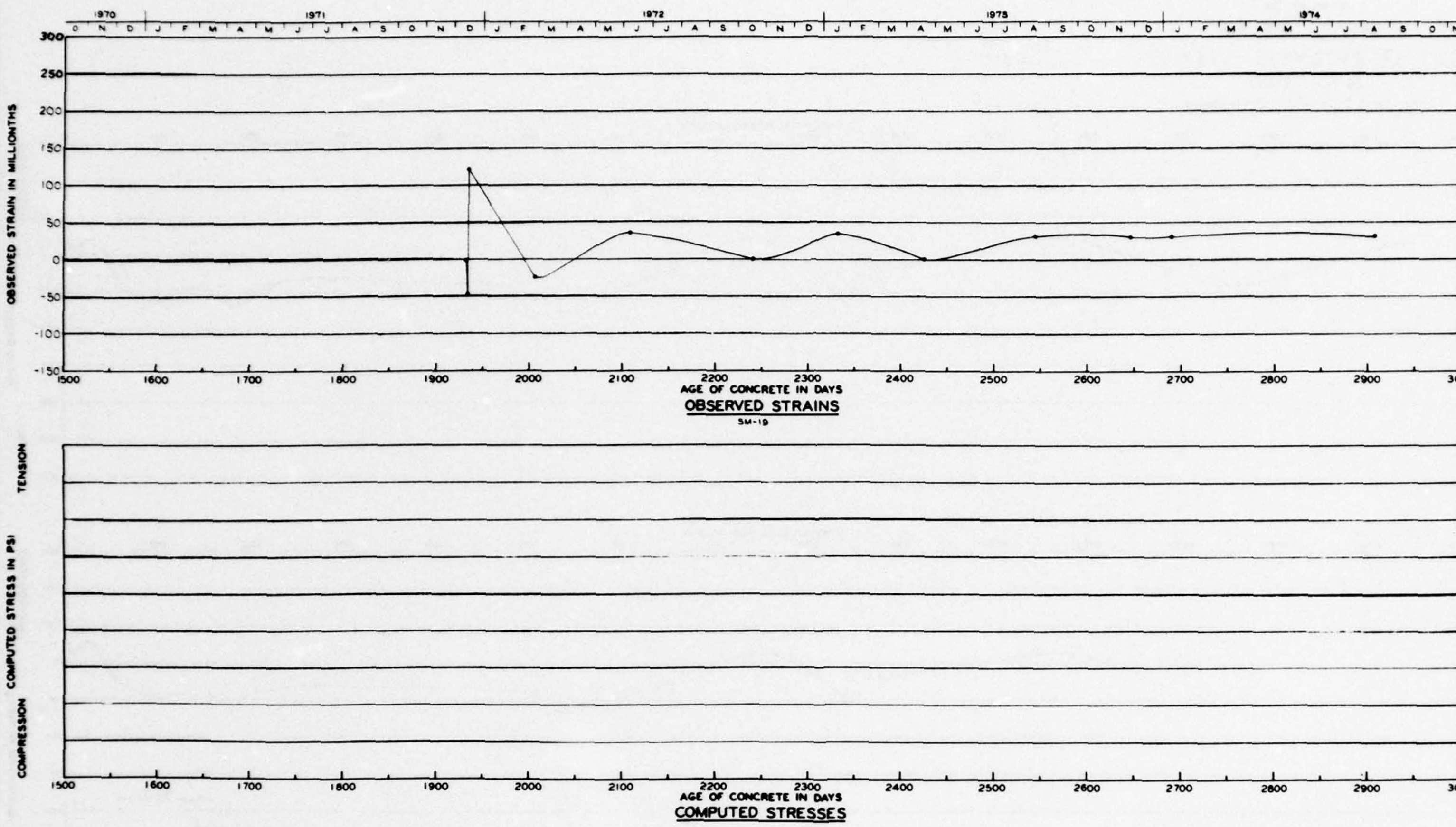
COMPUTED STRESSES

ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
CONCRETE STRAIN METER DATA
OBSERVED STRAINS
METERS SM-17 AND SM-18

PLATE 24

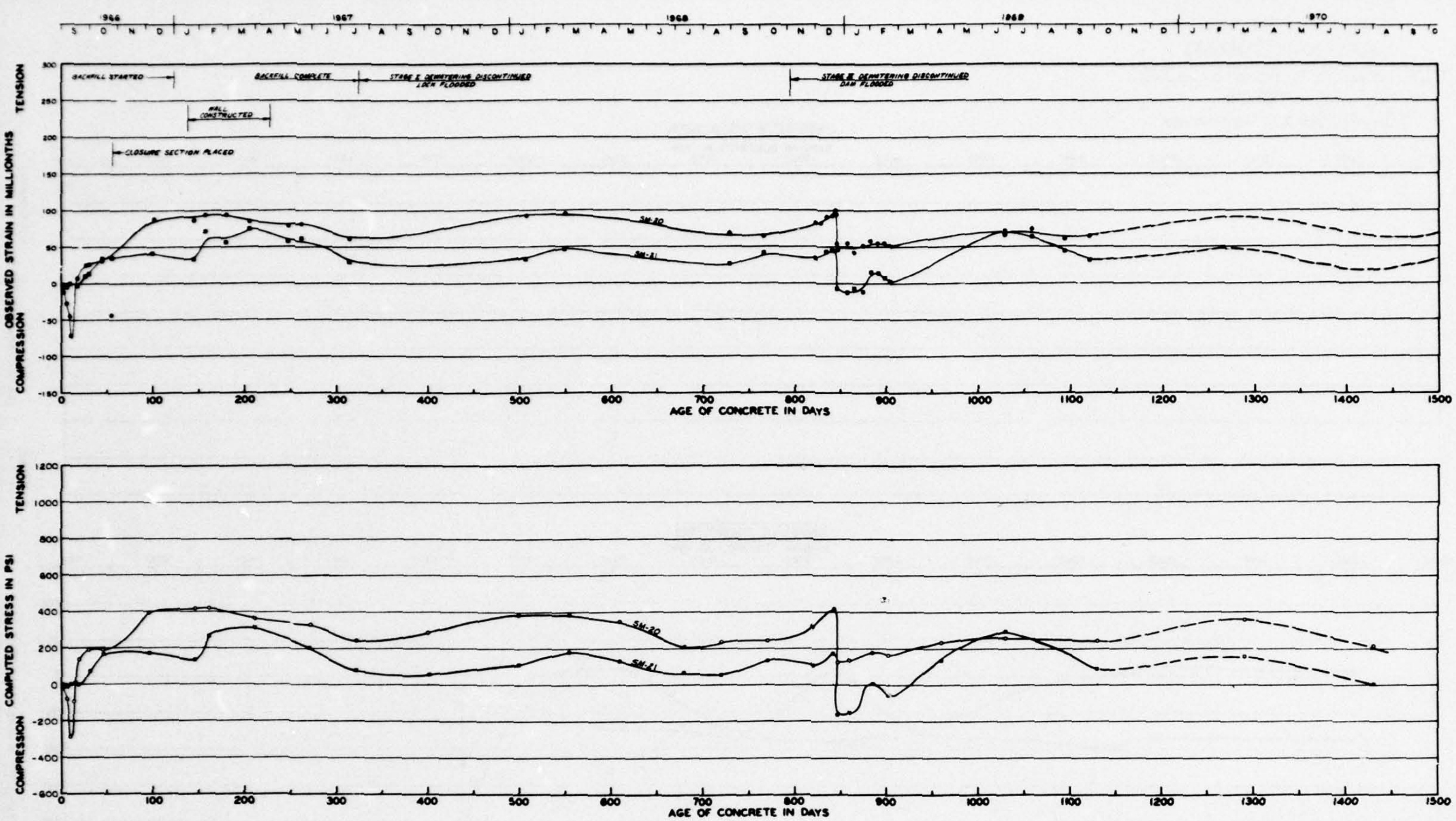


ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
CONCRETE STRAIN METER DATA
OBSERVED STRAINS
METER SM-19



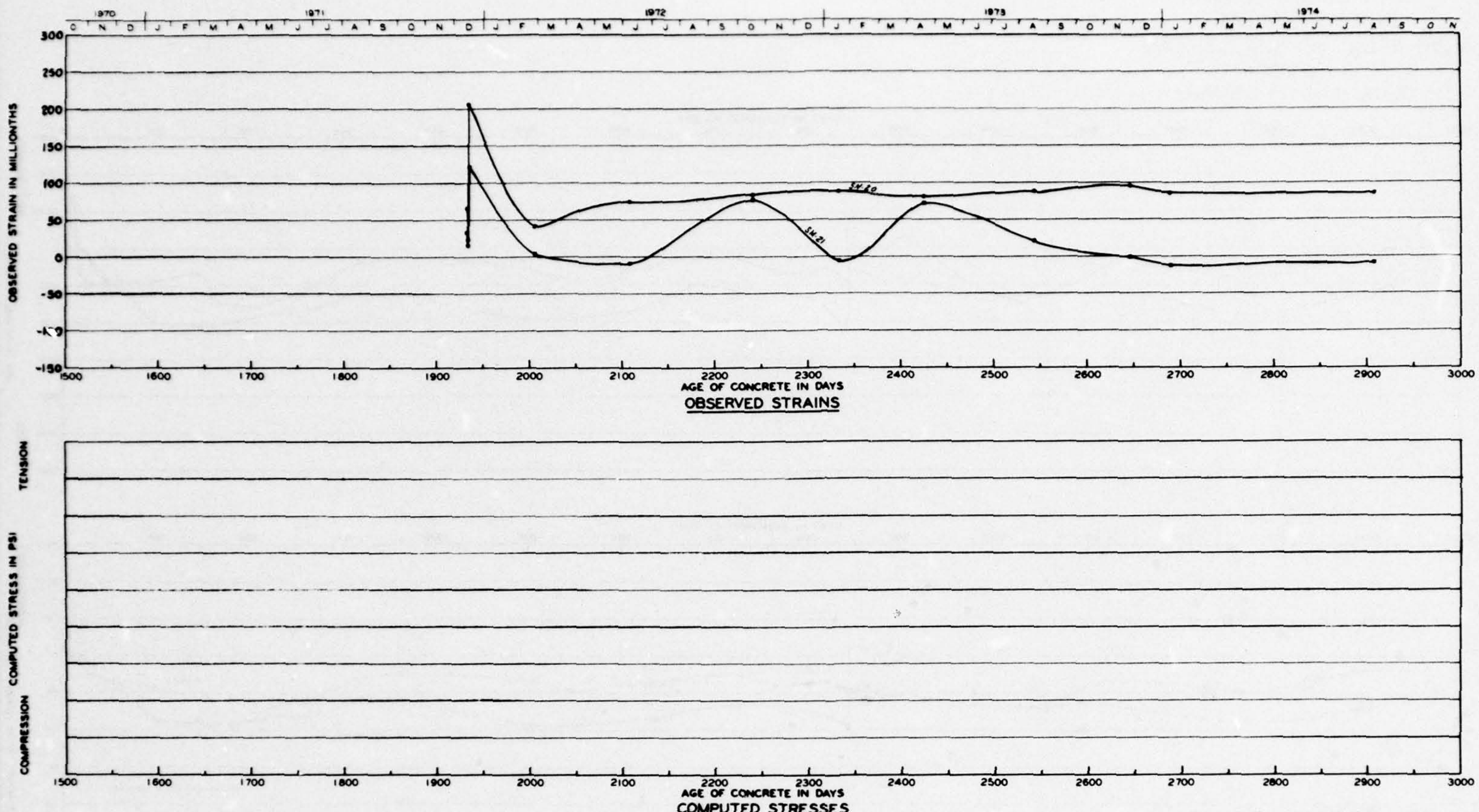
ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
CONCRETE STRAIN METER DATA
OBSERVED STRAINS
METER SM-19

PLATE 26



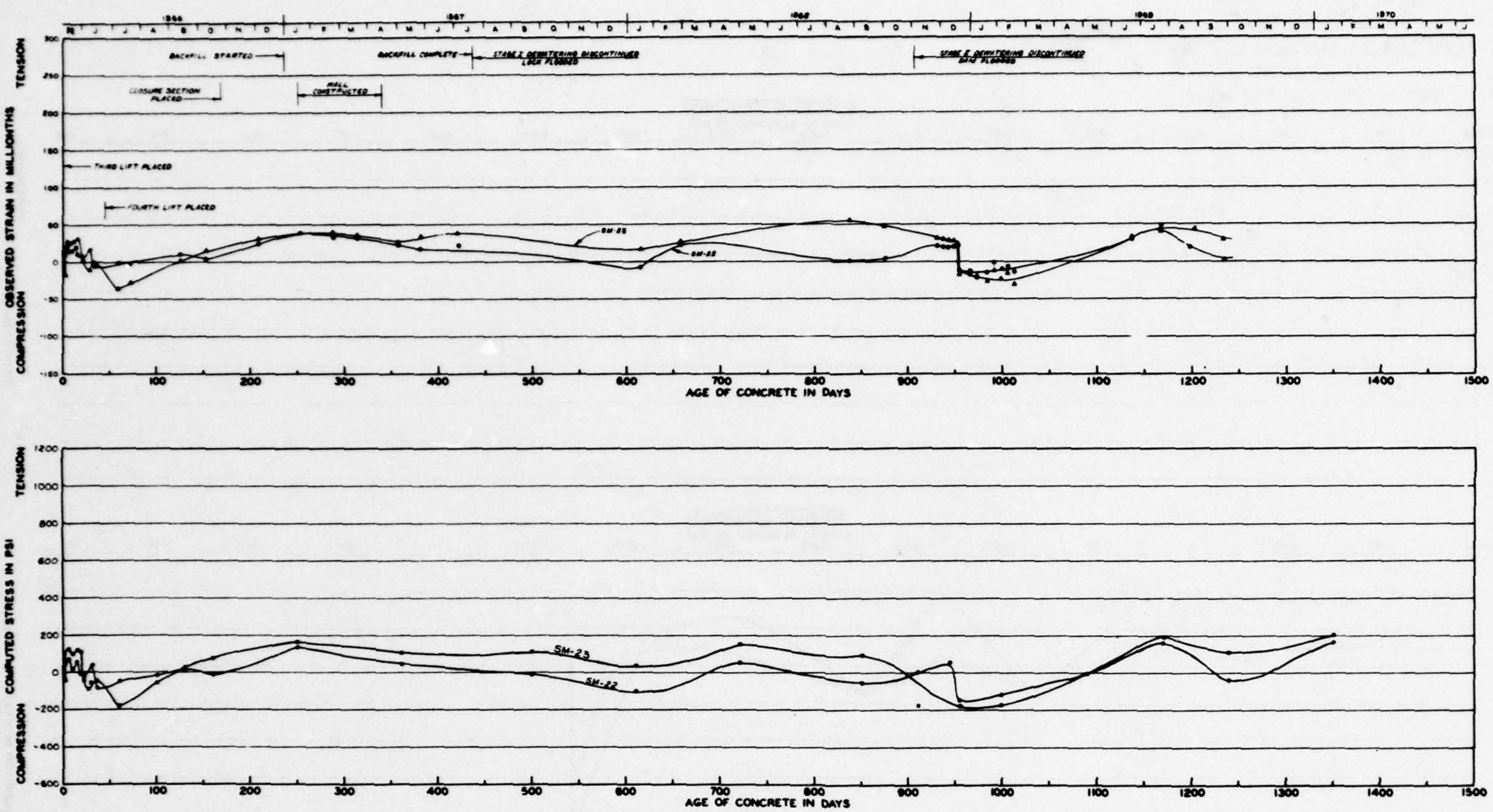
ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
CONCRETE STRAIN METER DATA
OBSERVED STRAINS
METERS SM-20 AND SM-21

PLATE 27



ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
CONCRETE STRAIN METER DATA
OBSERVED STRAINS
METERS SM-20 AND SM-21

PLATE 28



MONOLITH 18
CONCRETE STRAIN METER DATA
OBSERVED STRAINS
METERS SM-22 AND SM-23

PLATE 29

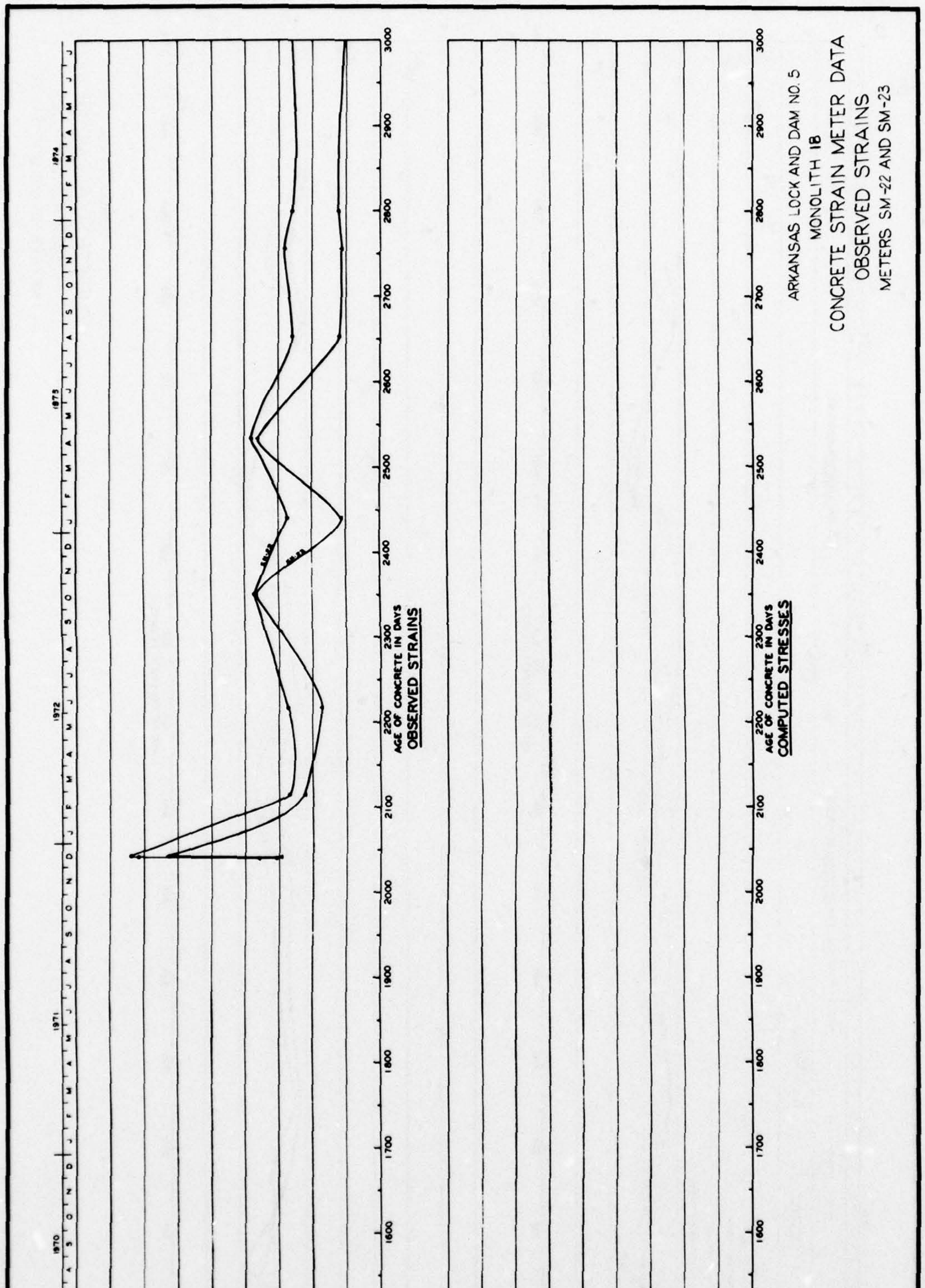
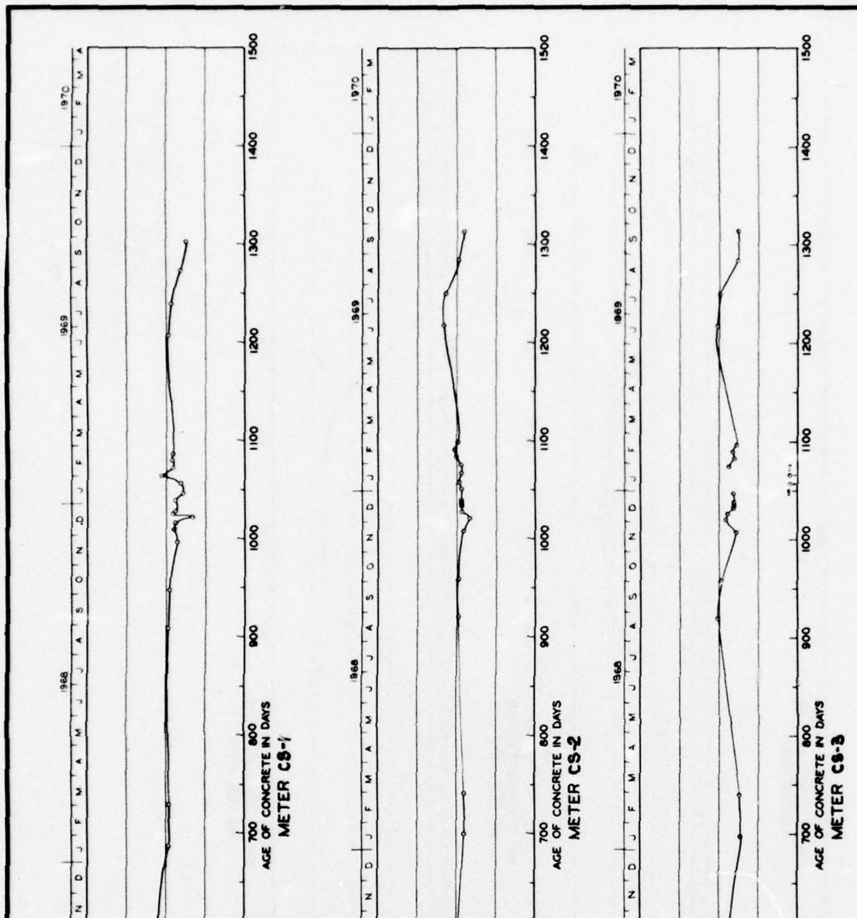
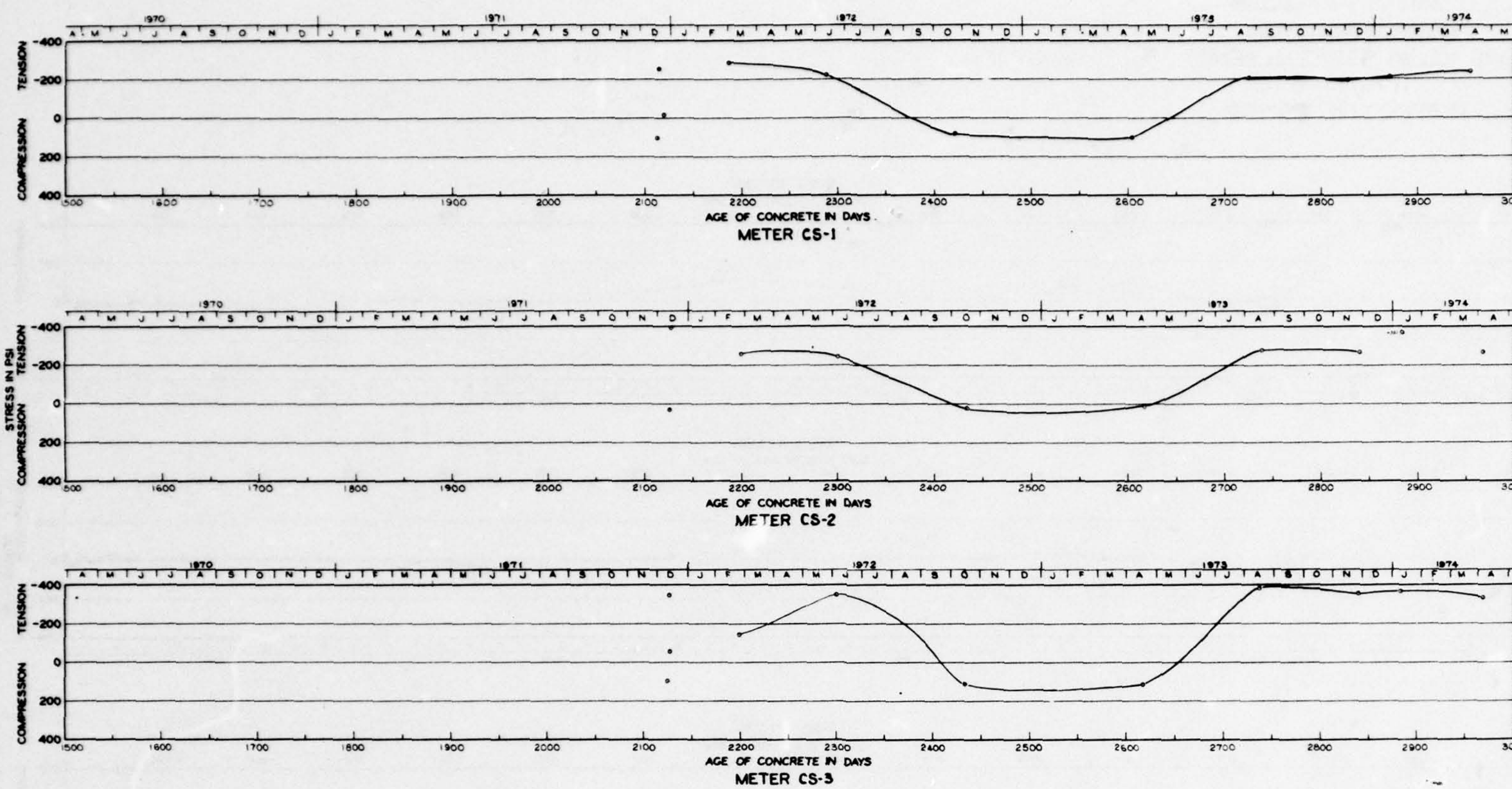

ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
CONCRETE STRAIN METER DATA
OBSERVED STRAINS
METERS SM-22 AND SM-23
OBSERVED STRAIN IN MILLIONTHS
AGE OF CONCRETE IN DAYS
OBSERVED STRAINS
COMPUTED STRESS IN PSI
TENSION
COMPRESSION
COMPUTED STRESSES
1970
1971
1972
1973
1974

PLATE 30

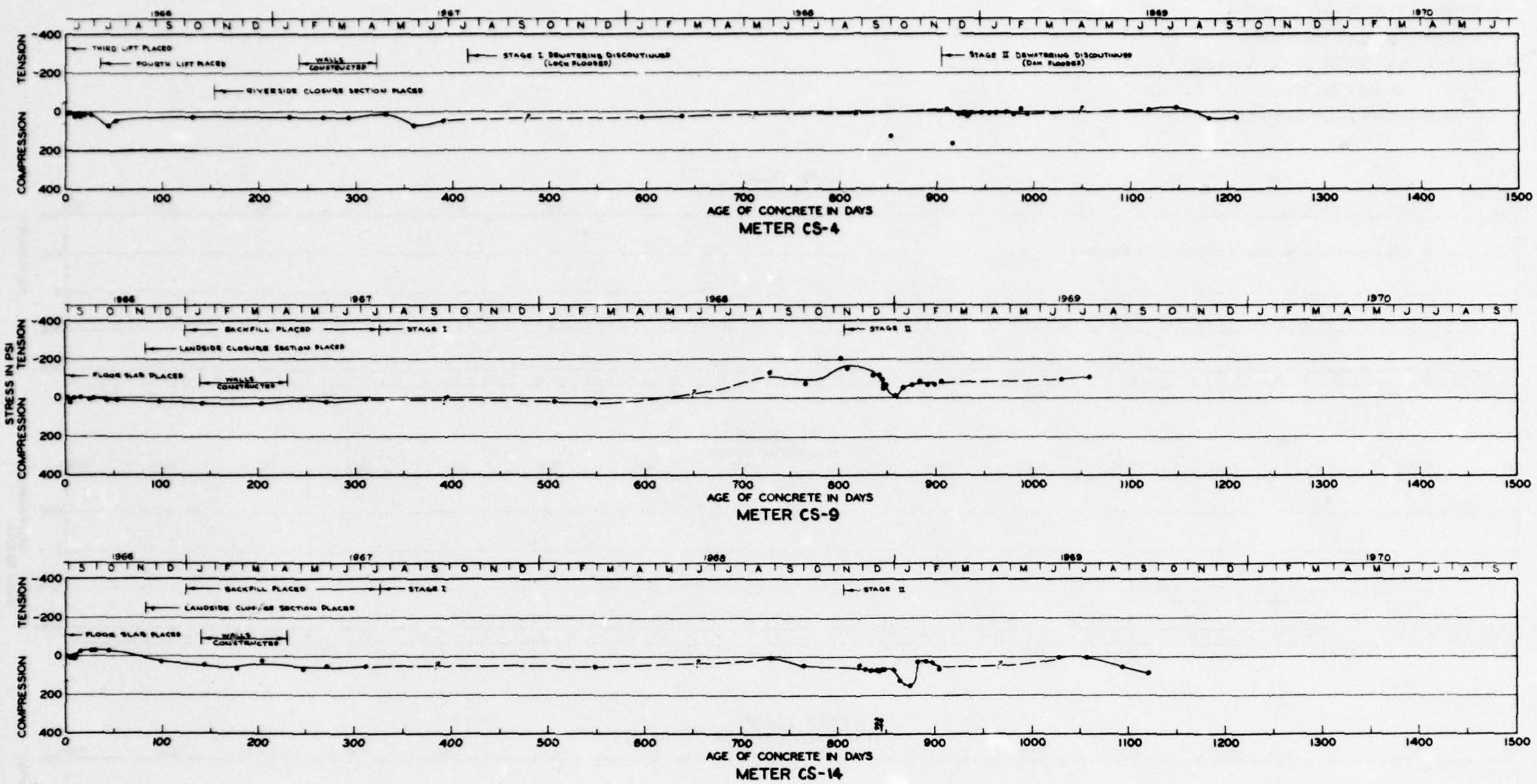


ARKANSAS LOCK AND DAM NO. 5
MONOLITH 11
CONCRETE STRESS METER DATA
OBSERVED STRESSES
METERS CS-1, CS-2 AND CS-3

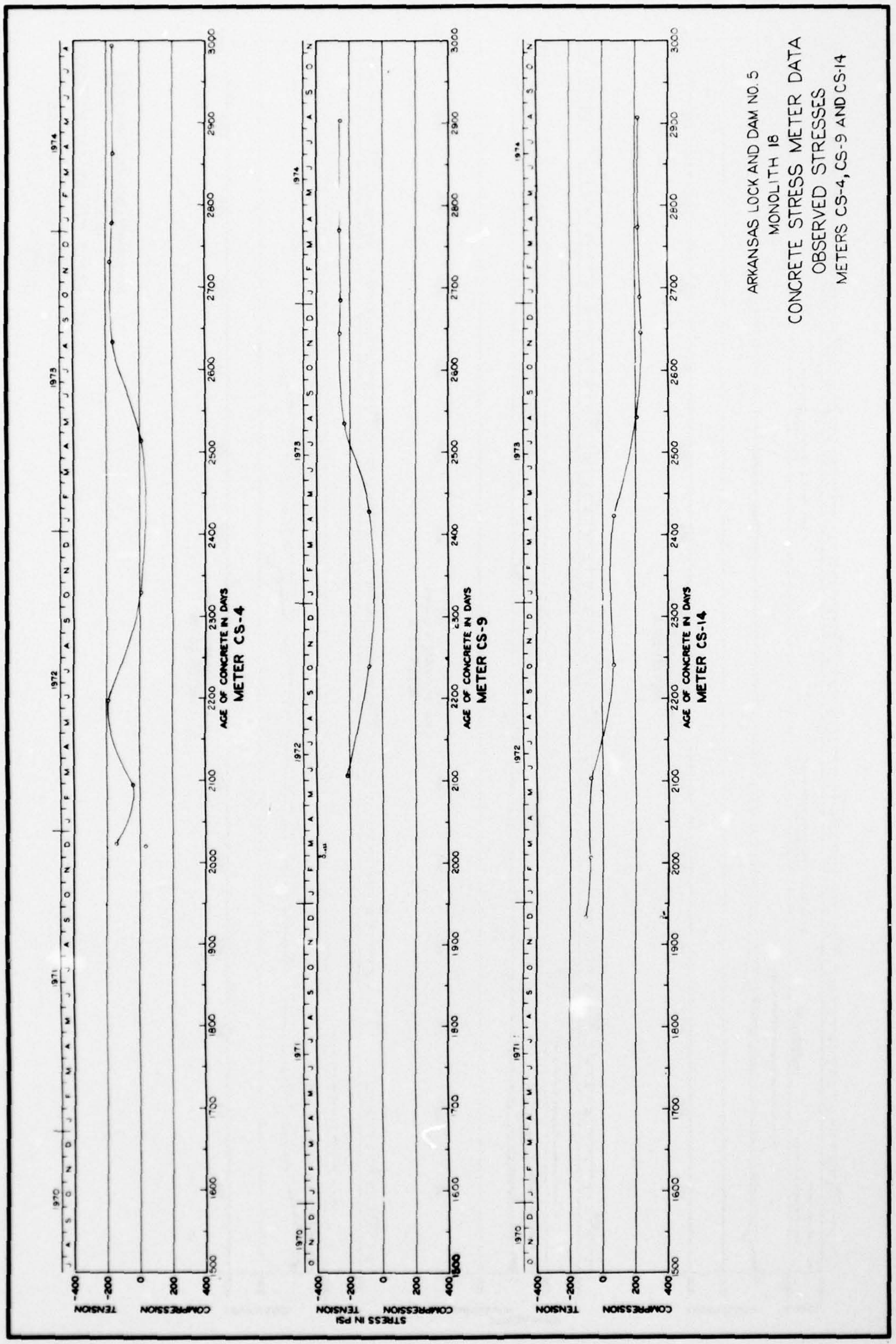
PLATE 31



ARKANSAS LOCK AND DAM NO. 5
MONOLITH 11
CONCRETE STRESS METER DATA
OBSERVED STRESSES
METERS CS-1, CS-2 AND CS-3

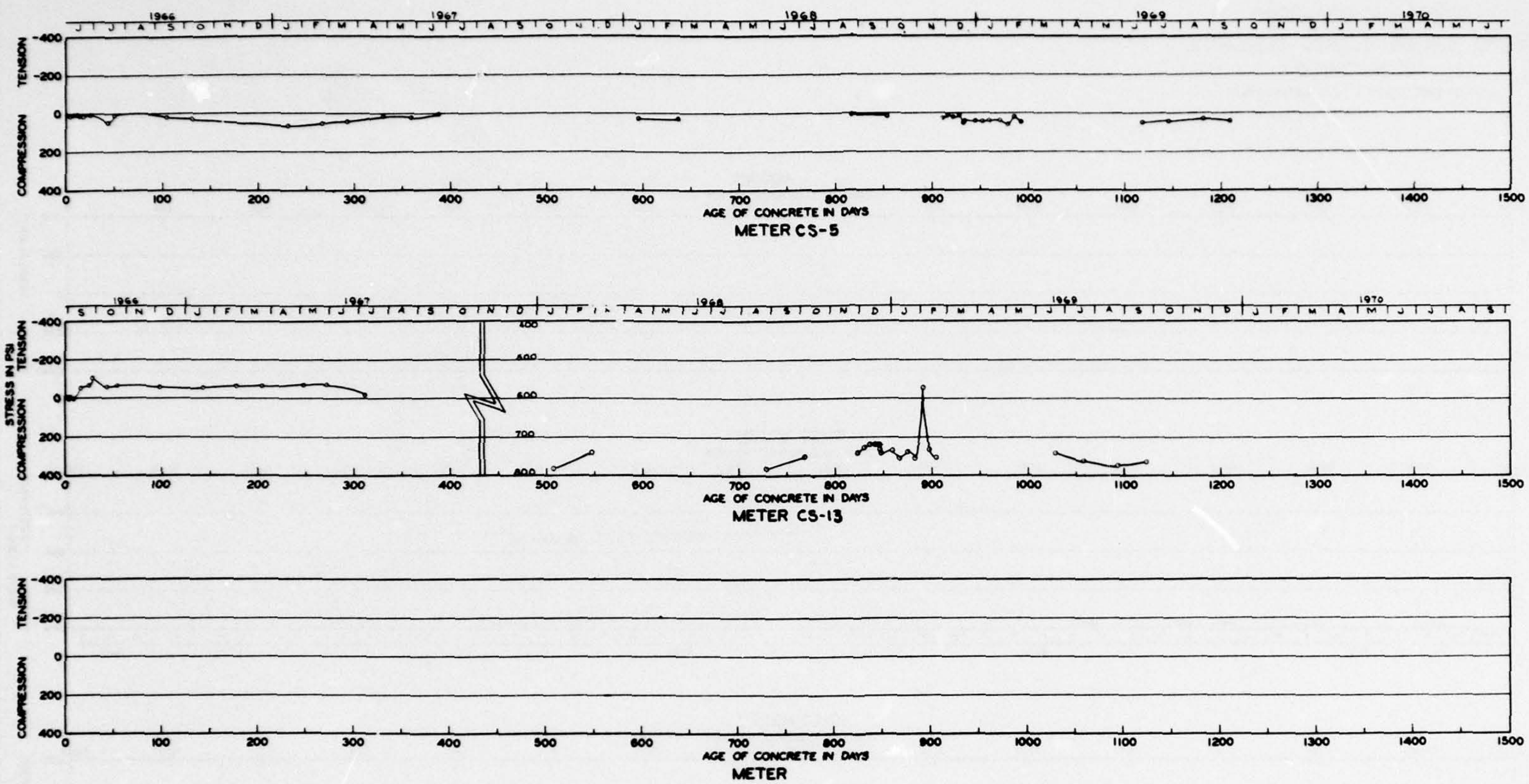


ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
CONCRETE STRESS METER DATA
OBSERVED STRESSES
METERS CS-4, CS-5 AND CS-14

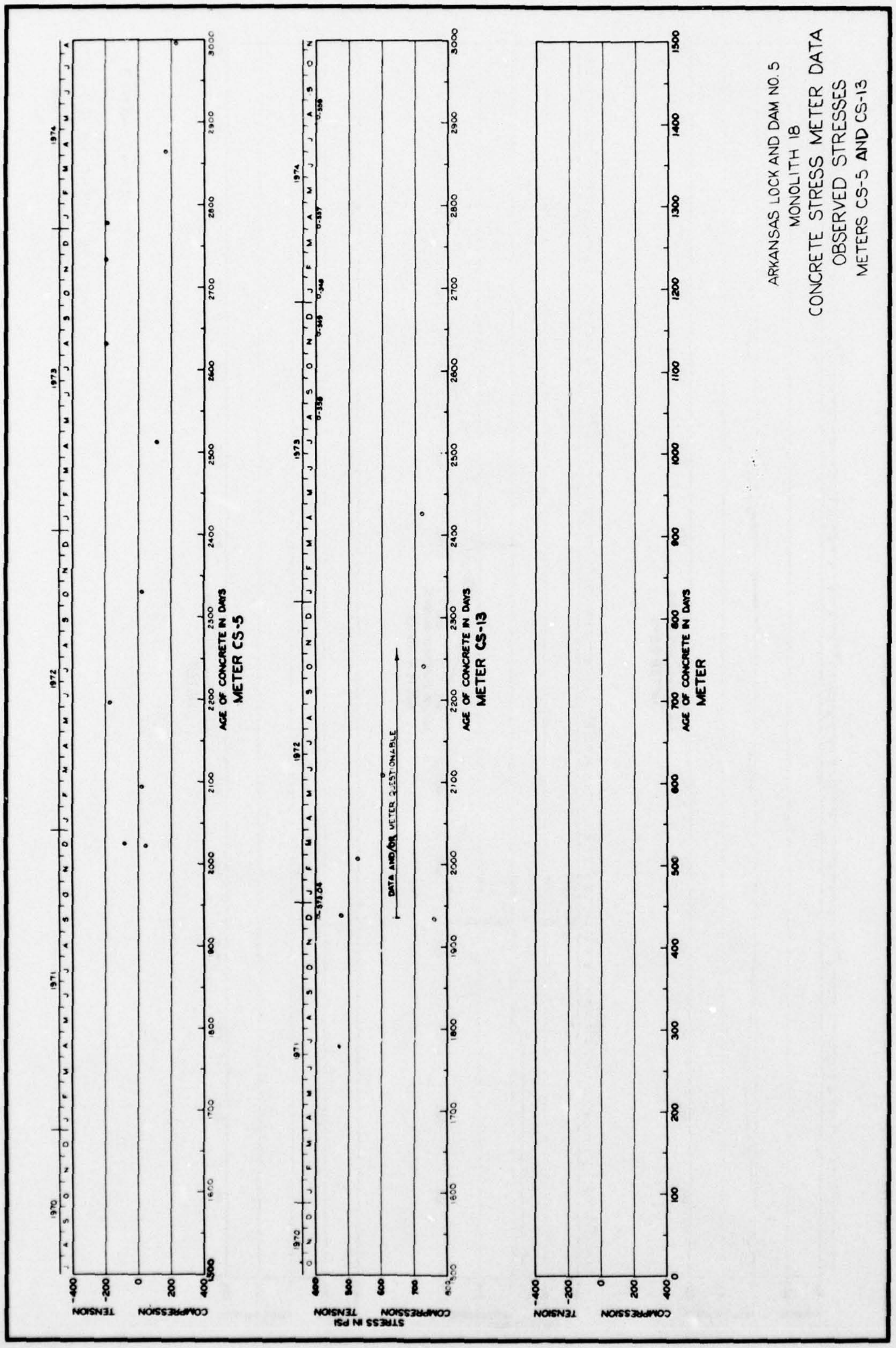


ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
CONCRETE STRESS METER DATA
OBSERVED STRESSES
METERS CS-4, CS-9 AND CS-14
METER CS-4
METER CS-9
METER CS-14
AGE OF CONCRETE IN DAYS
STRESS IN PSI
TENSION
COMPRESSION
1970
1971
1972
1973
1974

PLATE 34



ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
CONCRETE STRESS METER DATA
OBSERVED STRESSES
METERS CS-5 AND CS-13



ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
CONCRETE STRESS METER DATA
OBSERVED STRESSES
METERS CS-5 AND CS-13

PLATE 36

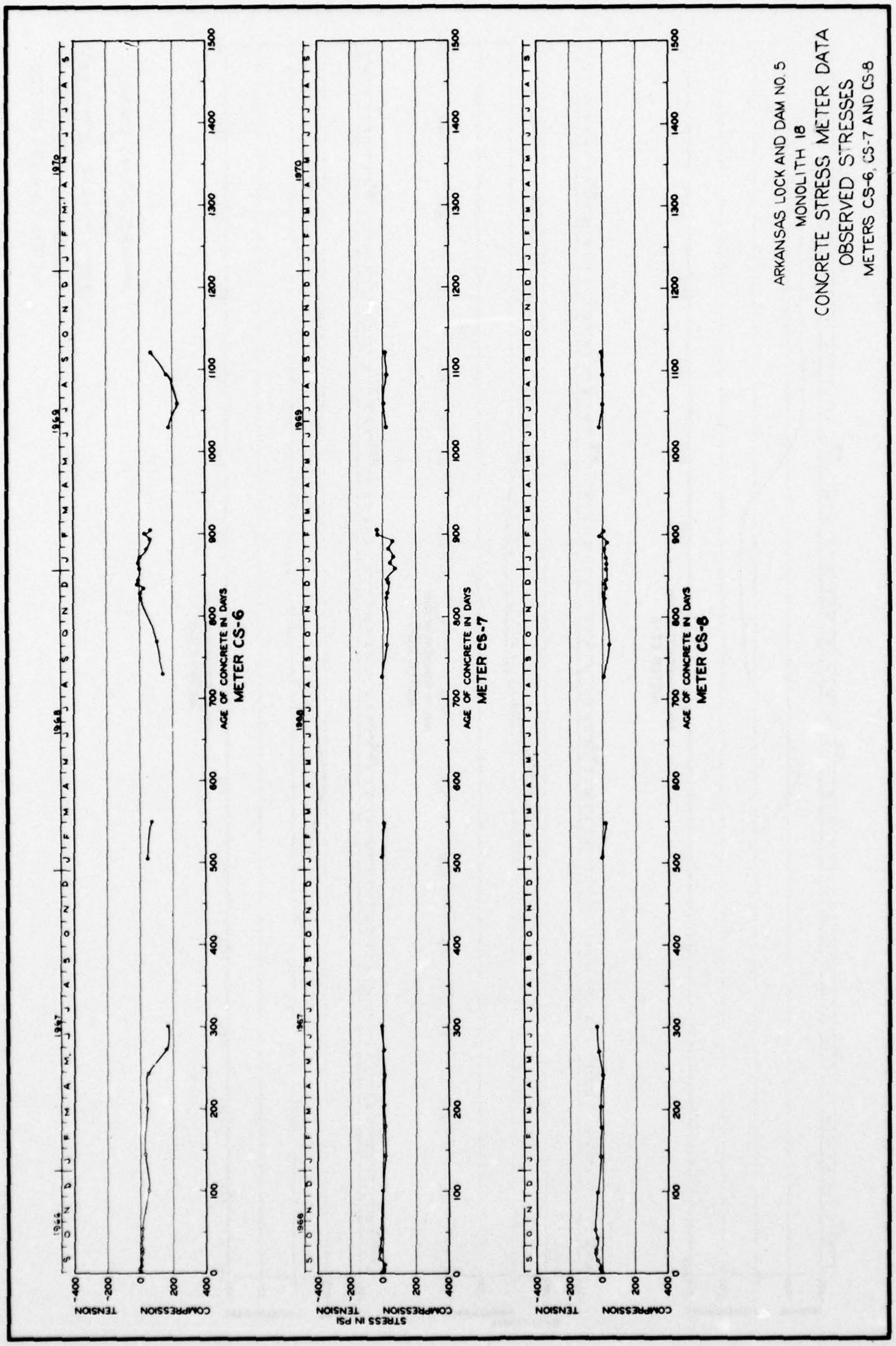
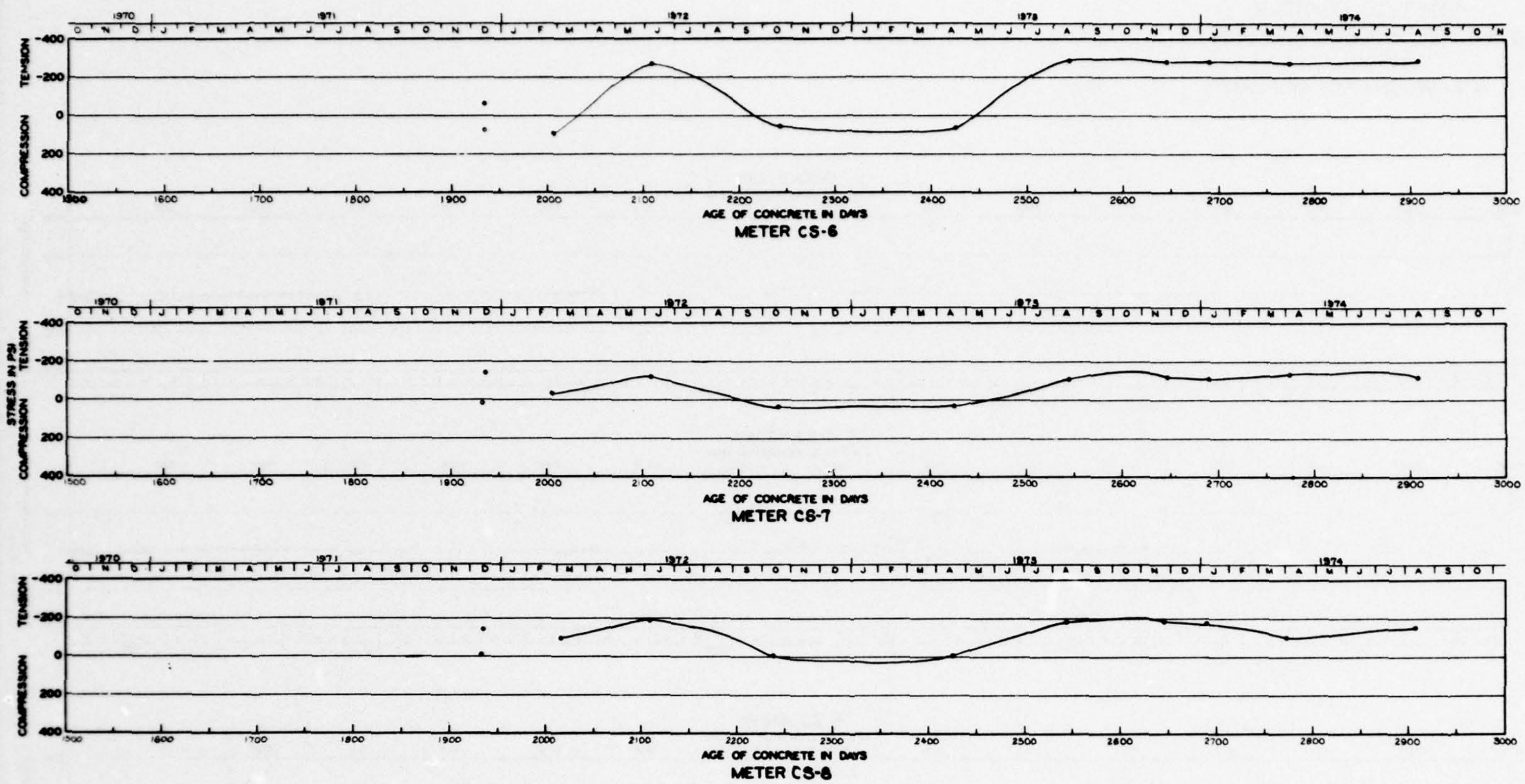
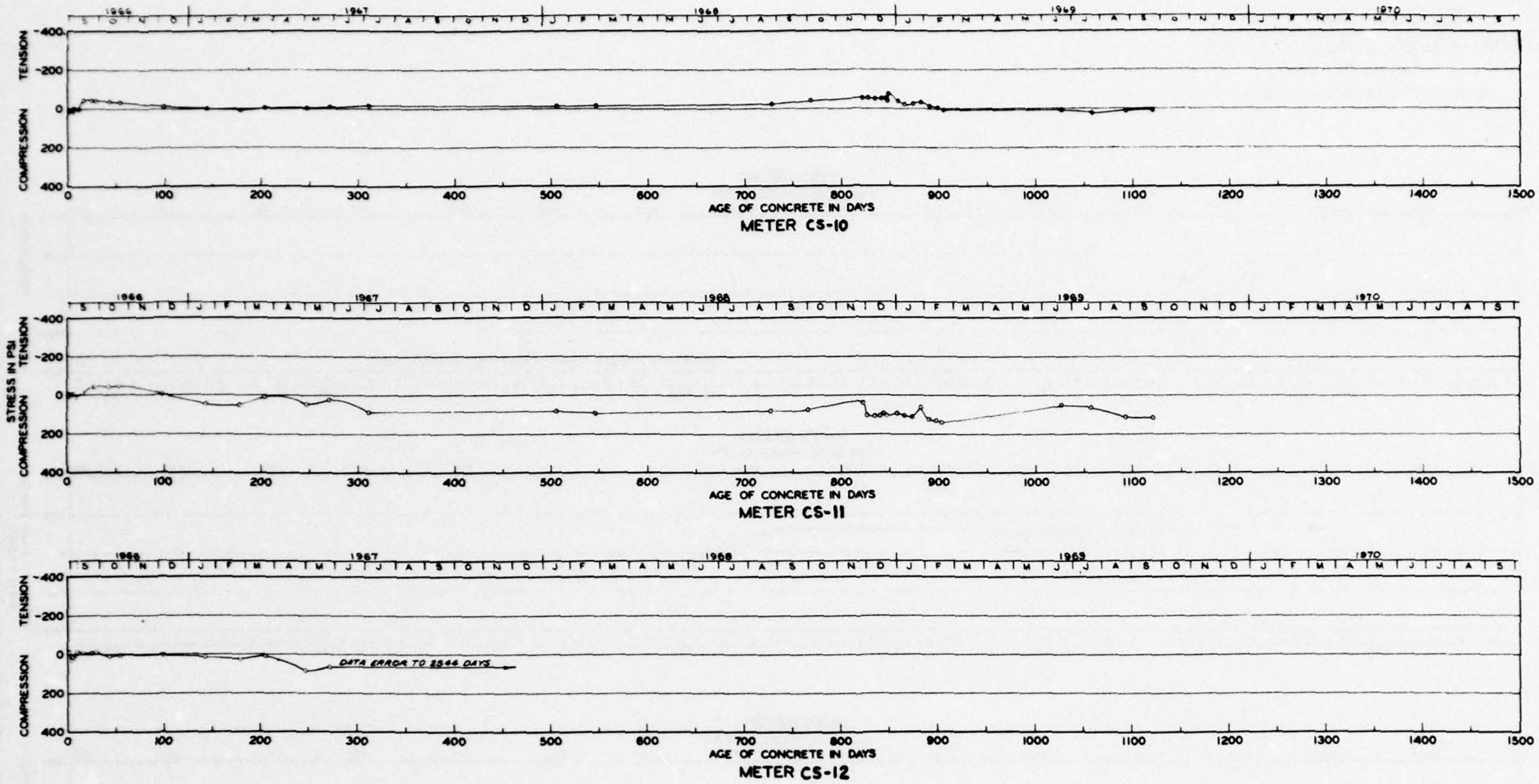

ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
CONCRETE STRESS METER DATA
OBSERVED STRESSES
METERS CS-6, CS-7 AND CS-8
METER CS-6
METER CS-7
METER CS-8
AGE OF CONCRETE IN DAYS
STRESS IN PSI
TENSION
COMPRESSION

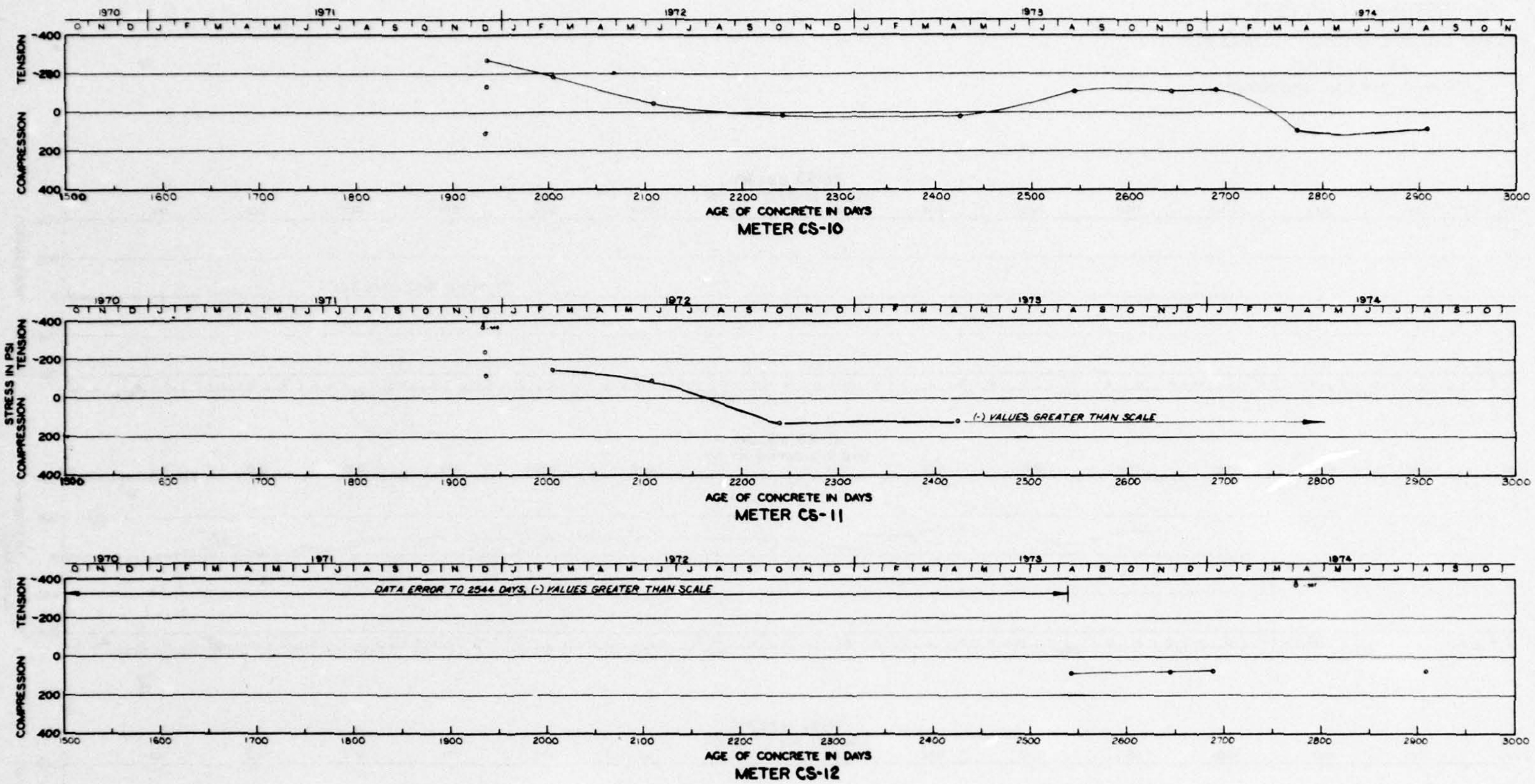
PLATE 37



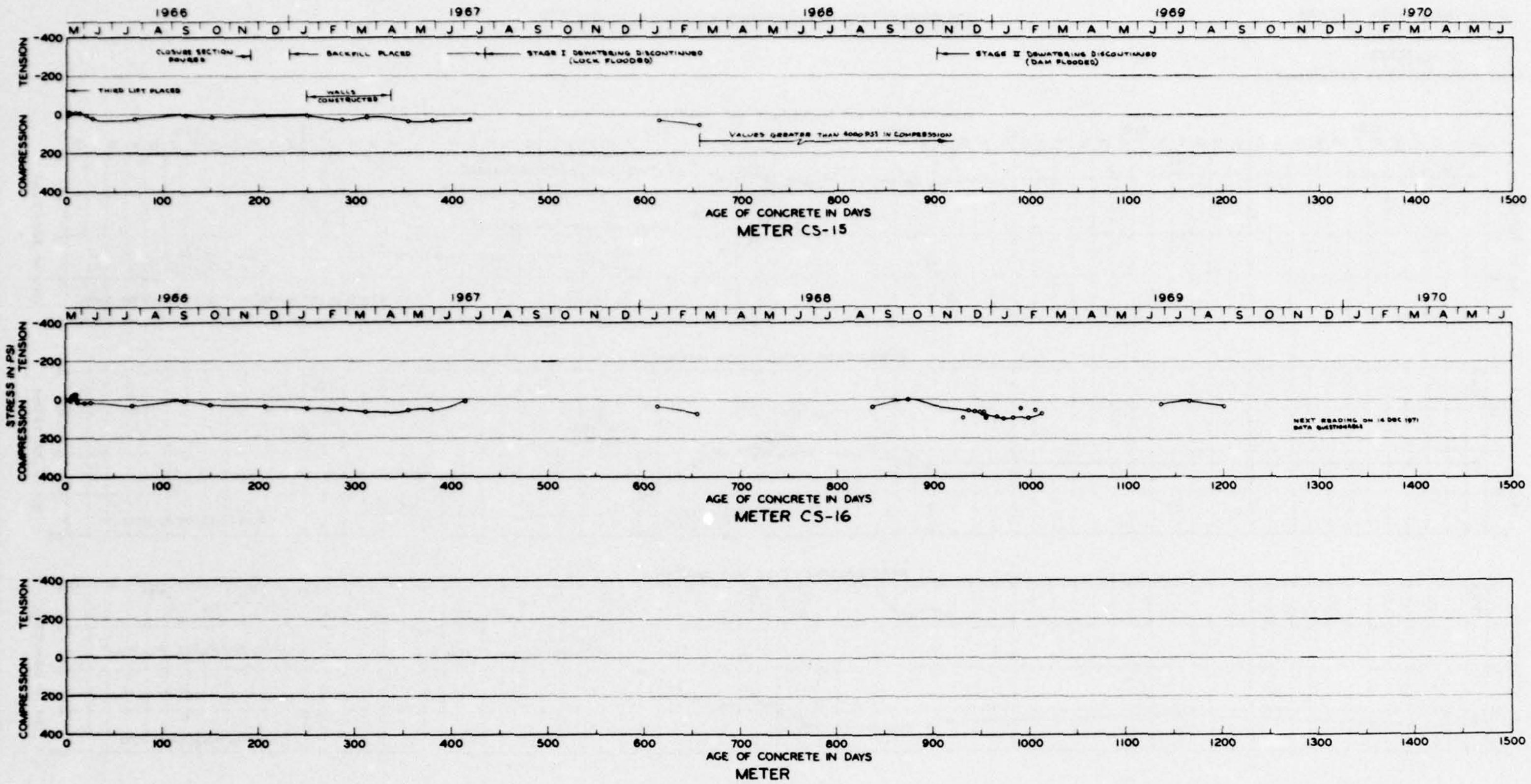
ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
CONCRETE STRESS METER DATA
OBSERVED STRESSES
METERS CS-6, CS-7 AND CS-8



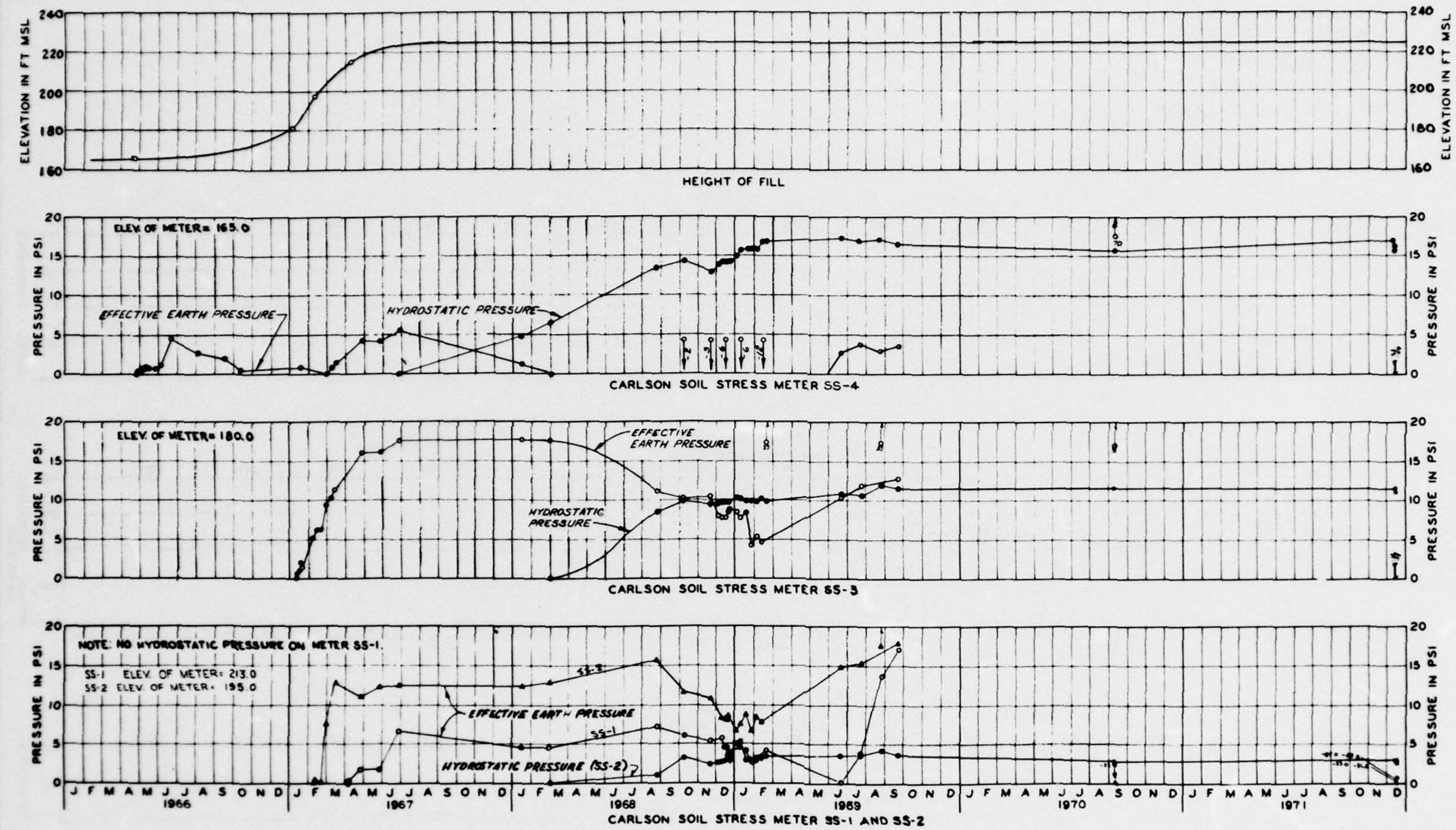
ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
CONCRETE STRESS METER DATA
OBSERVED STRESSES
METERS CS-10, CS-11 AND CS-12



ARKANSAS LOCK AND DAM NO. 5
MONOLITH 3
CONCRETE STRESS METER DATA
OBSERVED STRESSES
METERS CS-10, CS-11 AND CS-12

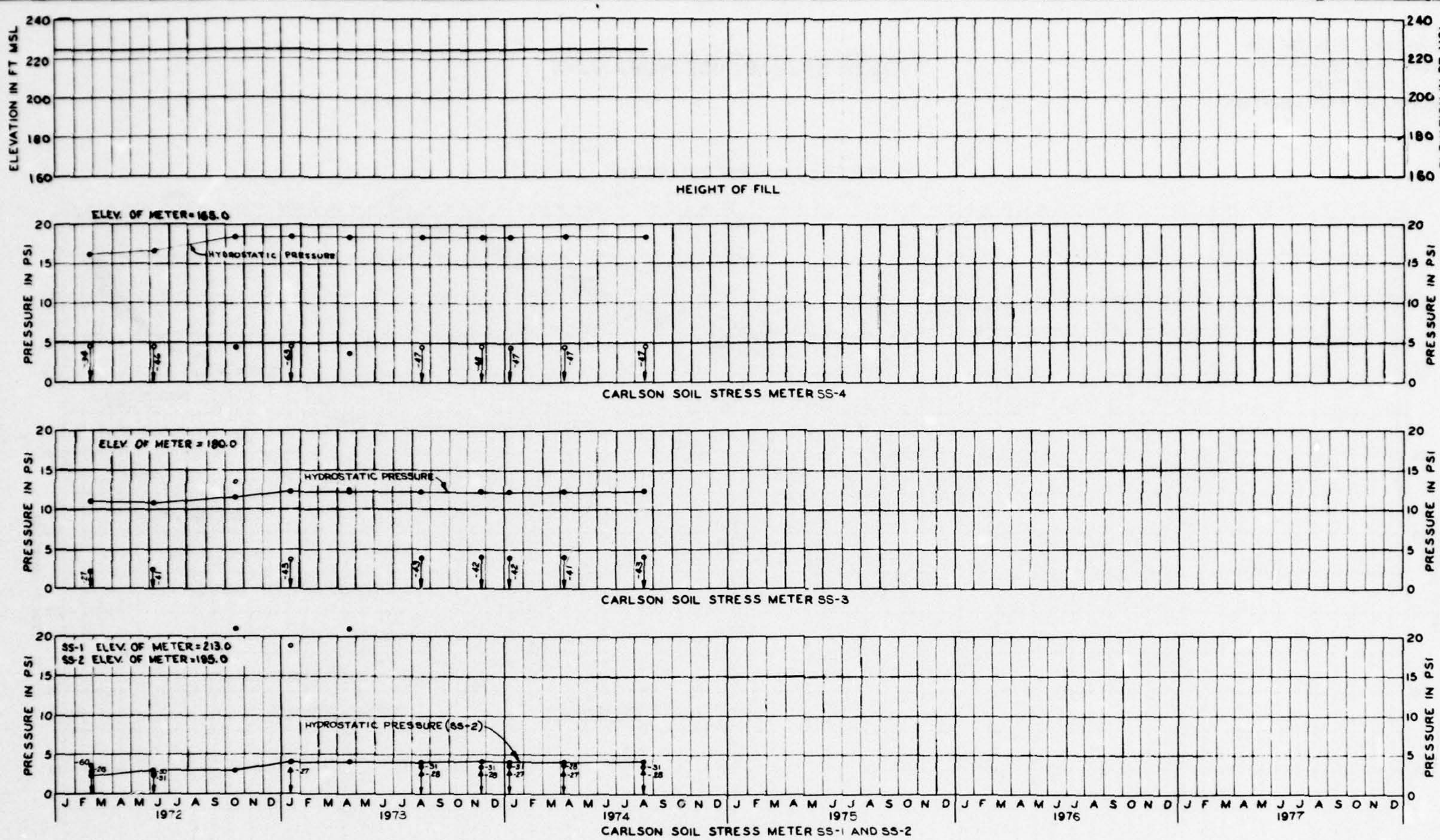


ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
CONCRETE STRESS METER DATA
OBSERVED STRESSES
METERS CS-15 AND CS-16



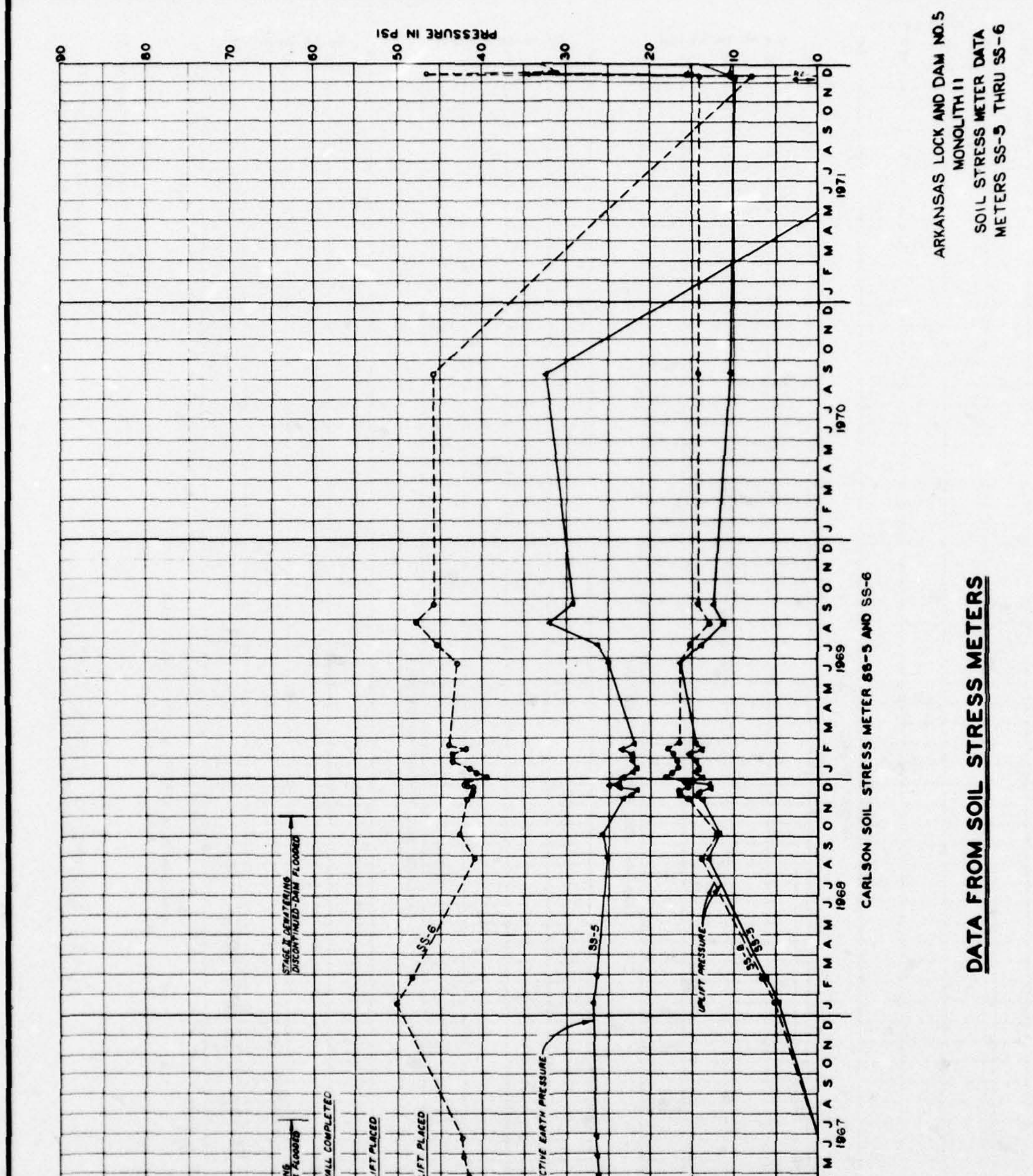
ARKANSAS LOCK AND DAM NO. 5
MONOLITH 10
SOIL STRESS METER DATA
METERS SS-1 THRU SS-4

DATA FROM SOIL STRESS METERS



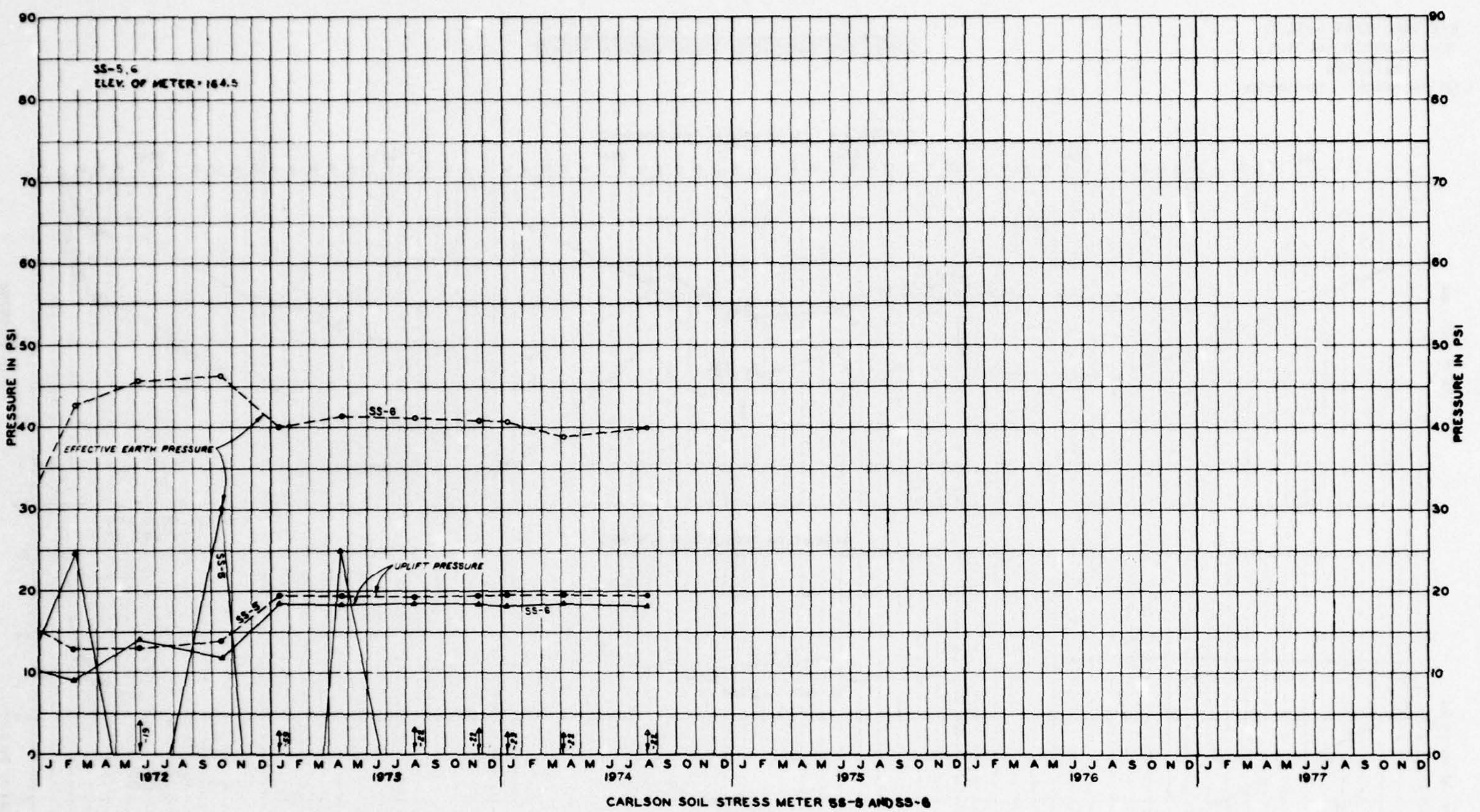
ARKANSAS LOCK AND DAM NO. 5
MONOLITH 10
SOIL STRESS METER DATA
METERS SS-1 THRU SS-4

DATA FROM SOIL STRESS METERS



DATA FROM SOIL STRESS METERS
ARKANSAS LOCK AND DAM NO.5
MONOLITH 11
SOIL STRESS METER DATA
METERS SS-5 THRU SS-6
CARLSON SOIL STRESS METER SS-5 AND SS-6
PRESSURE IN PSI
SS-5,6
ELEV. OF METER= 164.5
FIRST LIFT BASE SLAB PLACED
SECOND LIFT PLACED
THIRD LIFT PLACED
FOURTH LIFT-WALL STARTED
FIFTH LIFT PLACED
SIXTH LIFT PLACED
SEVENTH LIFT PLACED
EIGHTH LIFT PLACED
NINTH LIFT PLACED
WALL COMPLETED
STAGE I DEWATERING DISCONTINUED-LOCK FLOODED
STAGE II DEWATERING DISCONTINUED-DAM FLOODED
EFFECTIVE EARTH PRESSURE
UPLIFT PRESSURE
SS-6
SS-5
1966
1967
1968
1969
1970
1971

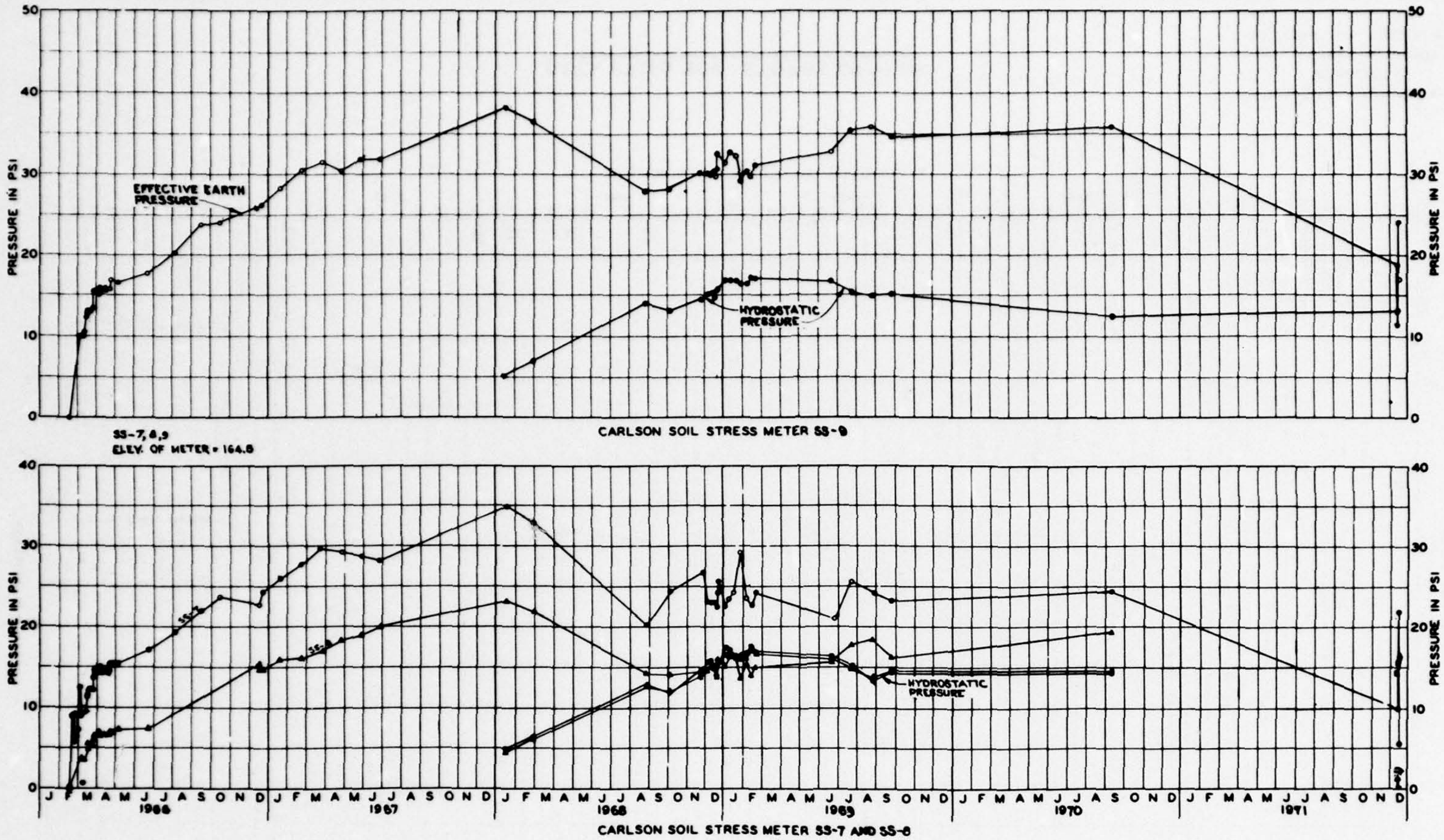
PLATE 44



DATA FROM SOIL STRESS METERS

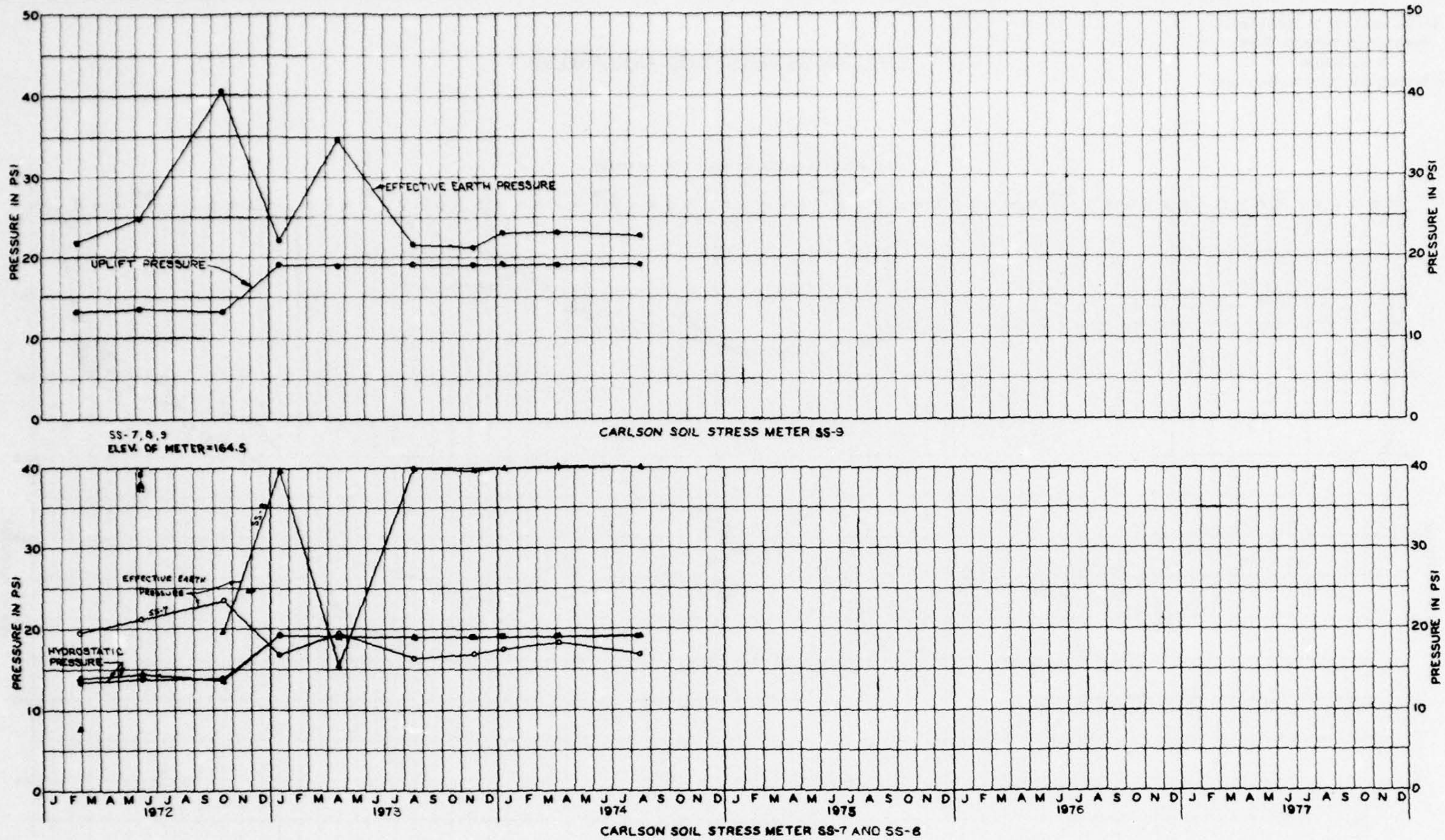
ARKANSAS LOCK AND DAM NO. 5
MONOLITH 11
SOIL STRESS METER DATA
METERS SS-5 THRU SS-6

PLATE 46



DATA FROM SOIL STRESS METERS

ARKANSAS LOCK AND DAM NO. 5
MONOLITH 11
SOIL STRESS METER DATA
METERS SS-7 THRU SS-9



DATA FROM SOIL STRESS METERS

ARKANSAS LOCK AND DAM NO. 5
MONOLITH 11
SOIL STRESS METER DATA
METERS SS-7 THRU SS-9

PLATE 47

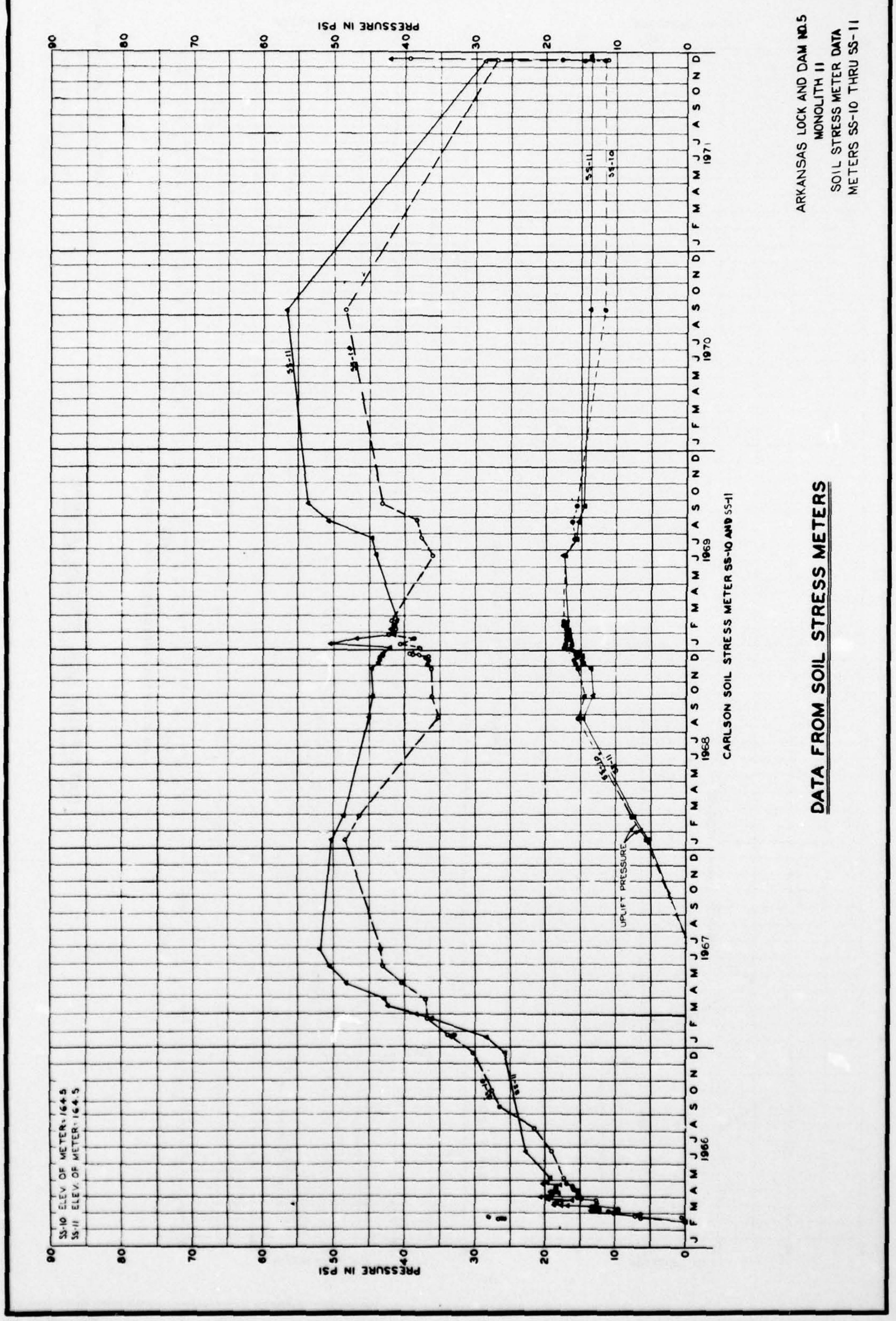
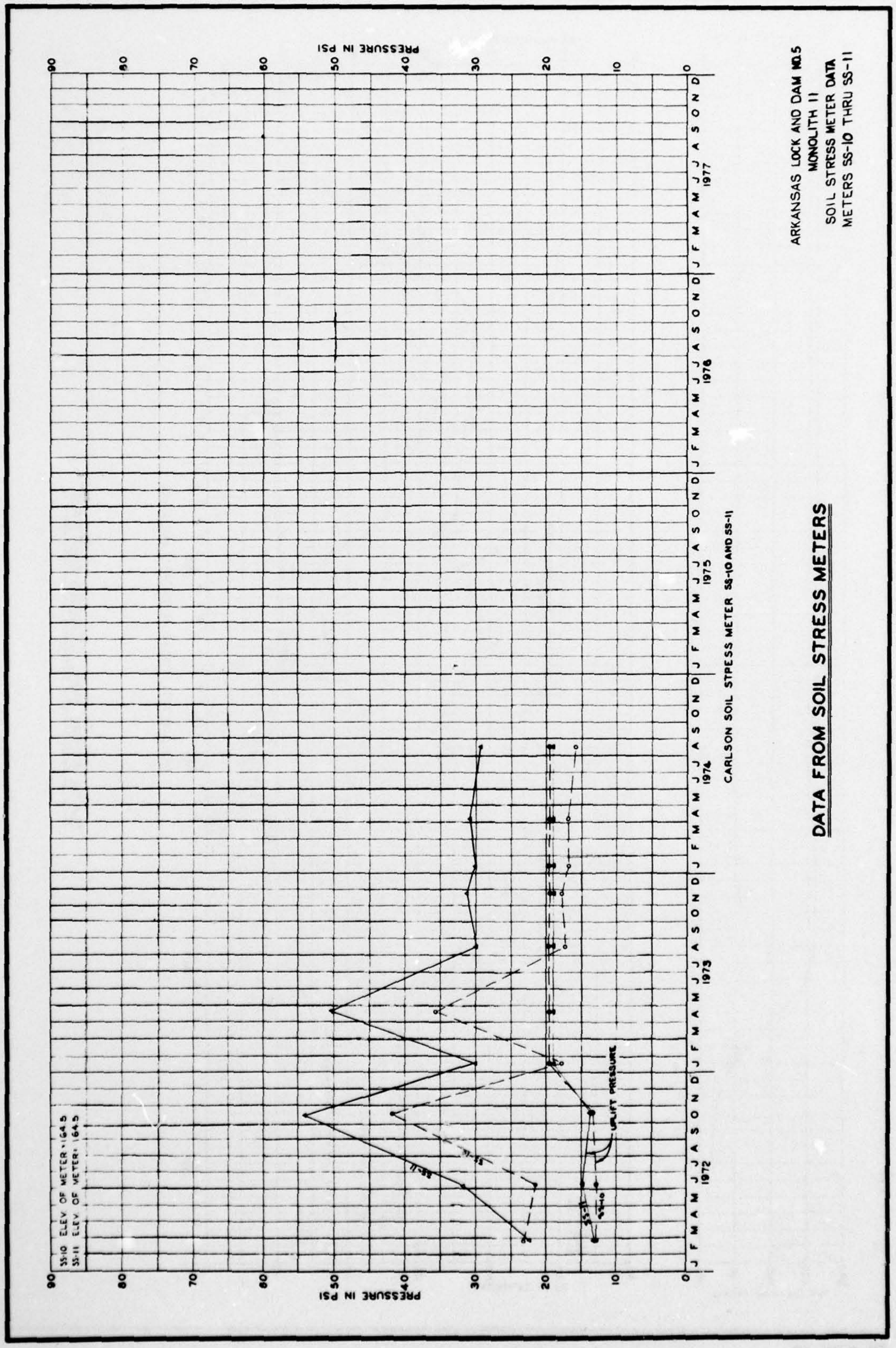
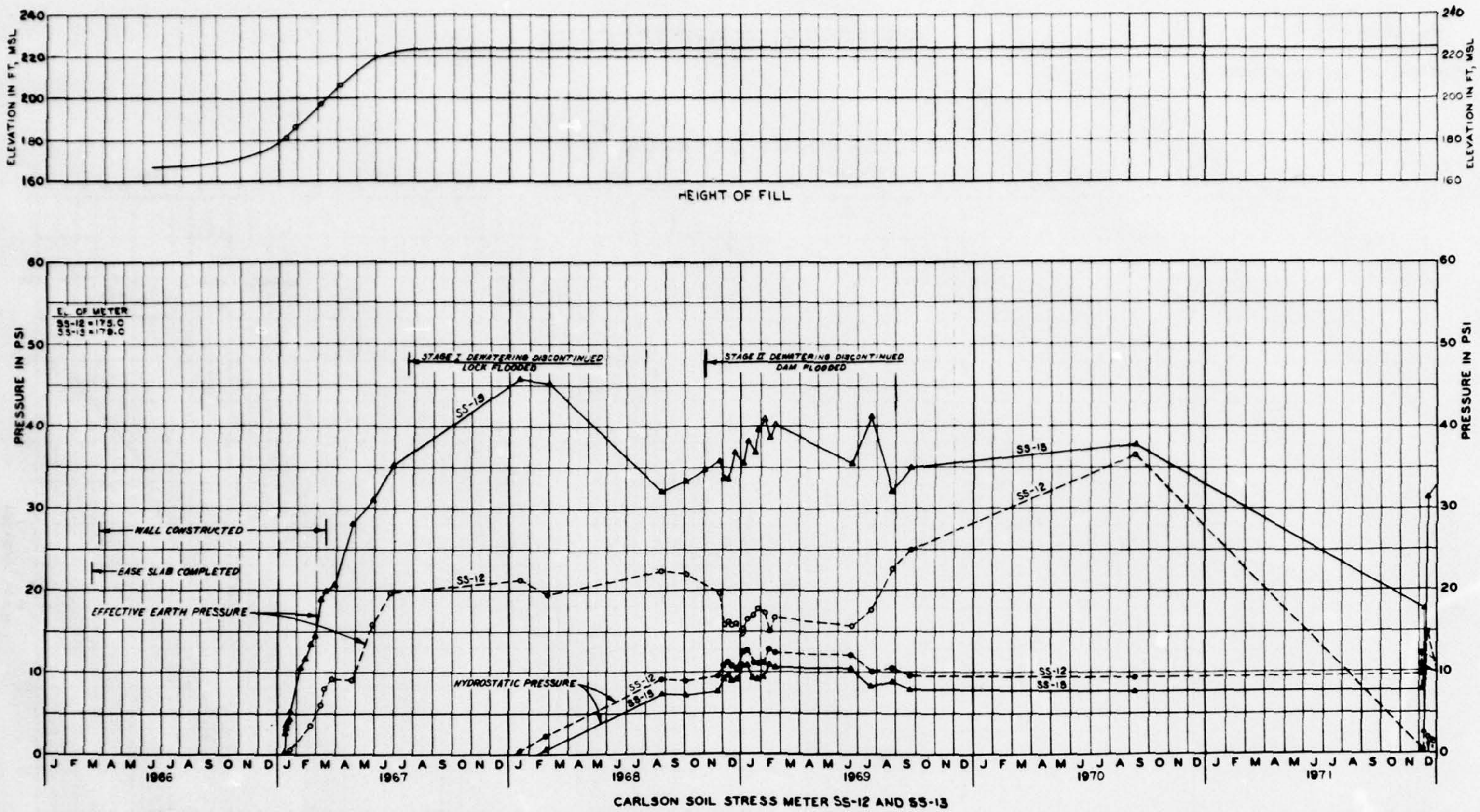

SS-10 ELEV. OF METER: 164.5
SS-11 ELEV. OF METER: 164.5
PRESSURE IN PSI
1966
1967
1968
1969
1970
1971
UPLIFT PRESSURE
SS-10
SS-11
CARLSON SOIL STRESS METER SS-10 AND SS-11
DATA FROM SOIL STRESS METERS
ARKANSAS LOCK AND DAM NO.5
MONOLITH 11
SOIL STRESS METER DATA
METERS SS-10 THRU SS-11

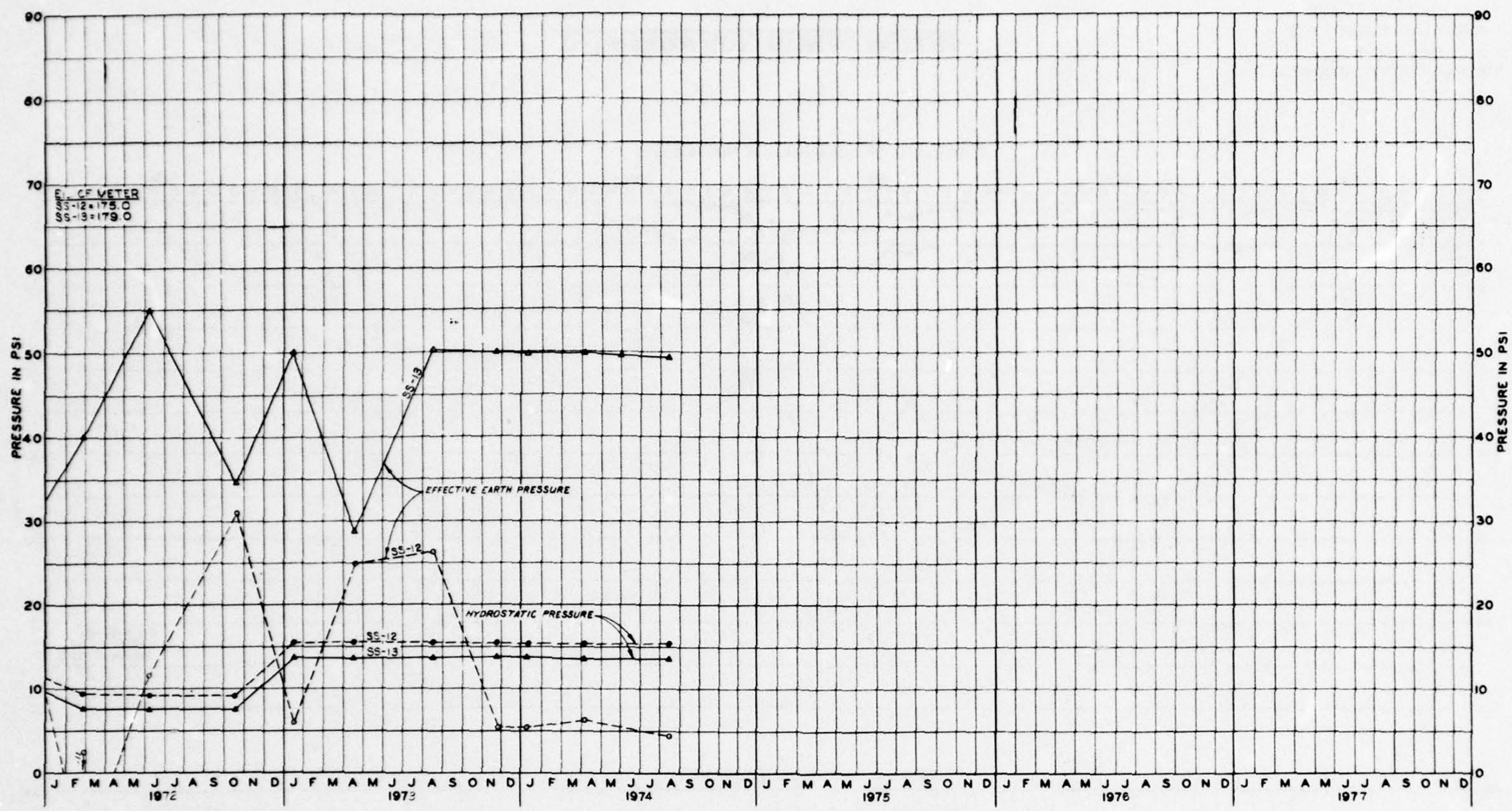
PLATE 48


DATA FROM SOIL STRESS METERS
ARKANSAS LOCK AND DAM NO. 5
MONOLITH 11
SOIL STRESS METER DATA
METERS SS-10 THRU SS-11
CARLSON SOIL STPESS METER SS-10 AND SS-11
PRESSURE IN PSI
SS-10 ELEV OF METER 164.5
SS-11 ELEV OF METER 164.5
UPLIFT PRESSURE
SS-11
SS-10
1972
1973
1974
1975
1976
1977



DATA FROM SOIL STRESS METERS

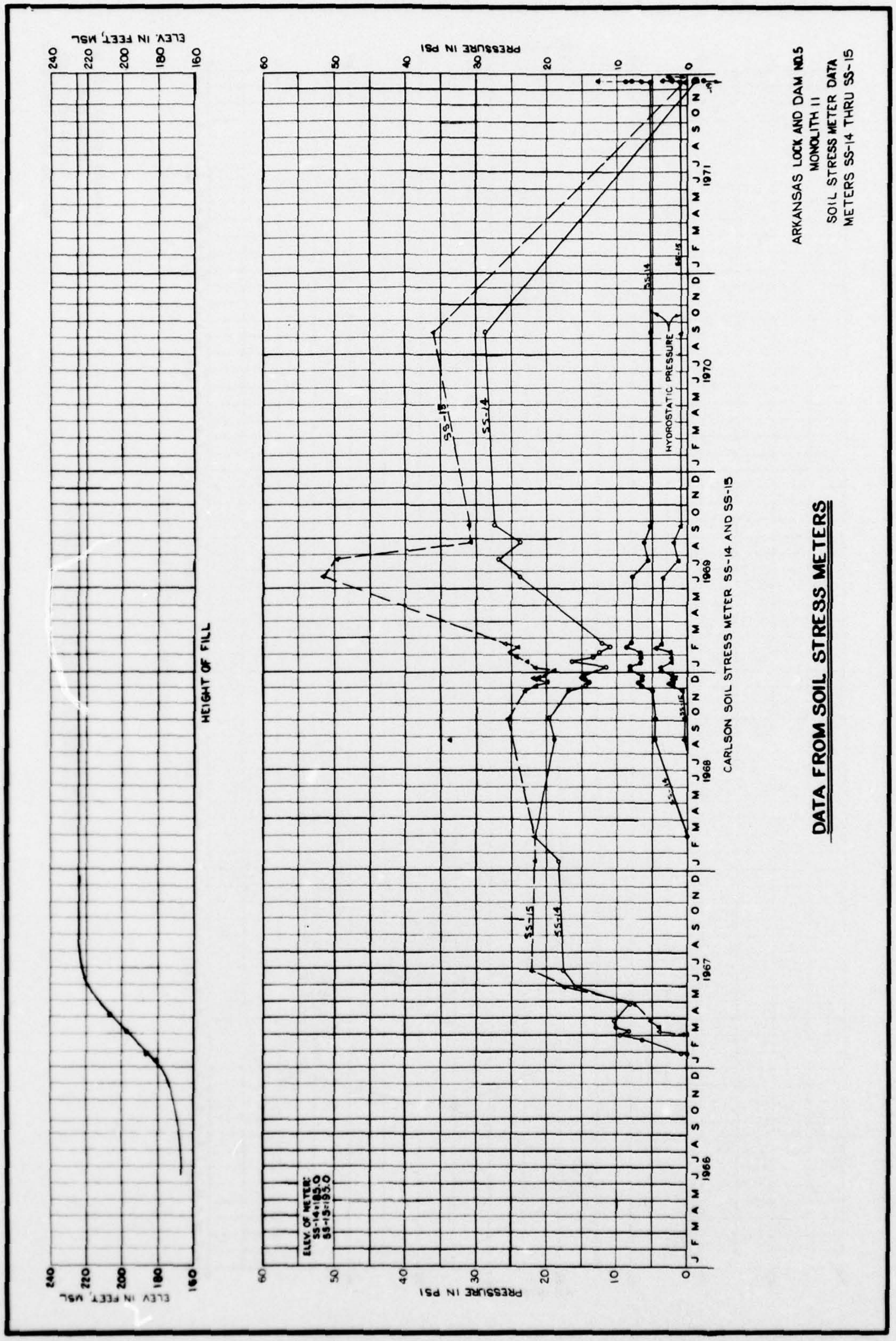
ARKANSAS LOCK AND DAM NO.5
MONOLITH 11
SOIL STRESS METER DATA
METERS SS-12 THRU SS-13



CARLSON SOIL STRESS METER SS-12 AND SS-13

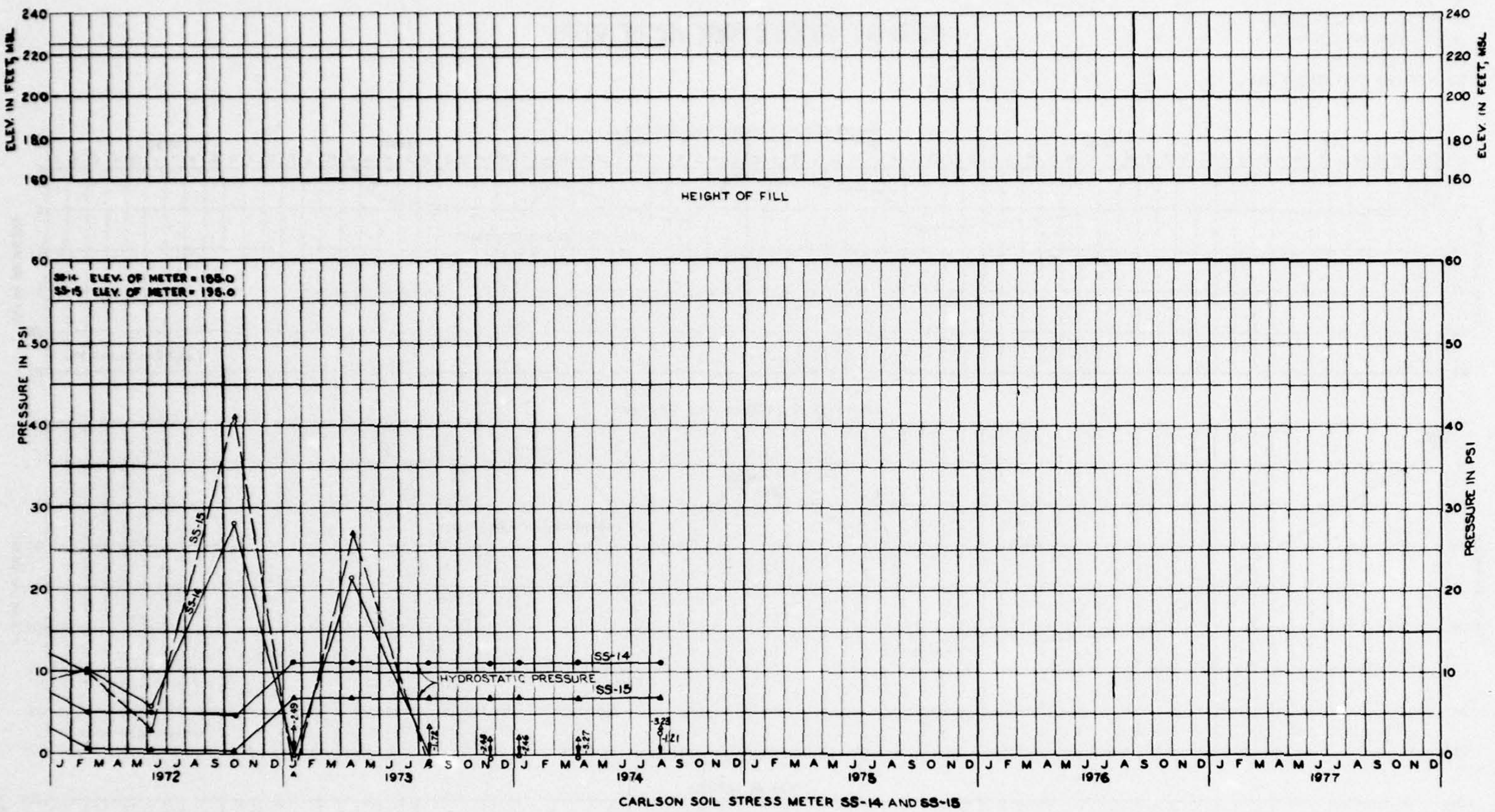
DATA FROM SOIL STRESS METERS

ARKANSAS LOCK AND DAM NO.5
MONOLITH 11
SOIL STRESS METER DATA
METERS SS-12 THRU SS-13



DATA FROM SOIL STRESS METERS
ARKANSAS LOCK AND DAM NO.5
MONOLITH 11
SOIL STRESS METER DATA
METERS SS-14 THRU SS-15
HEIGHT OF FILL
ELEV. IN FEET, MSL
PRESSURE IN PSI
CARLSON SOIL STRESS METER SS-14 AND SS-15
HYDROSTATIC PRESSURE
SS-14
SS-15
1966
1967
1968
1969
1970
1971

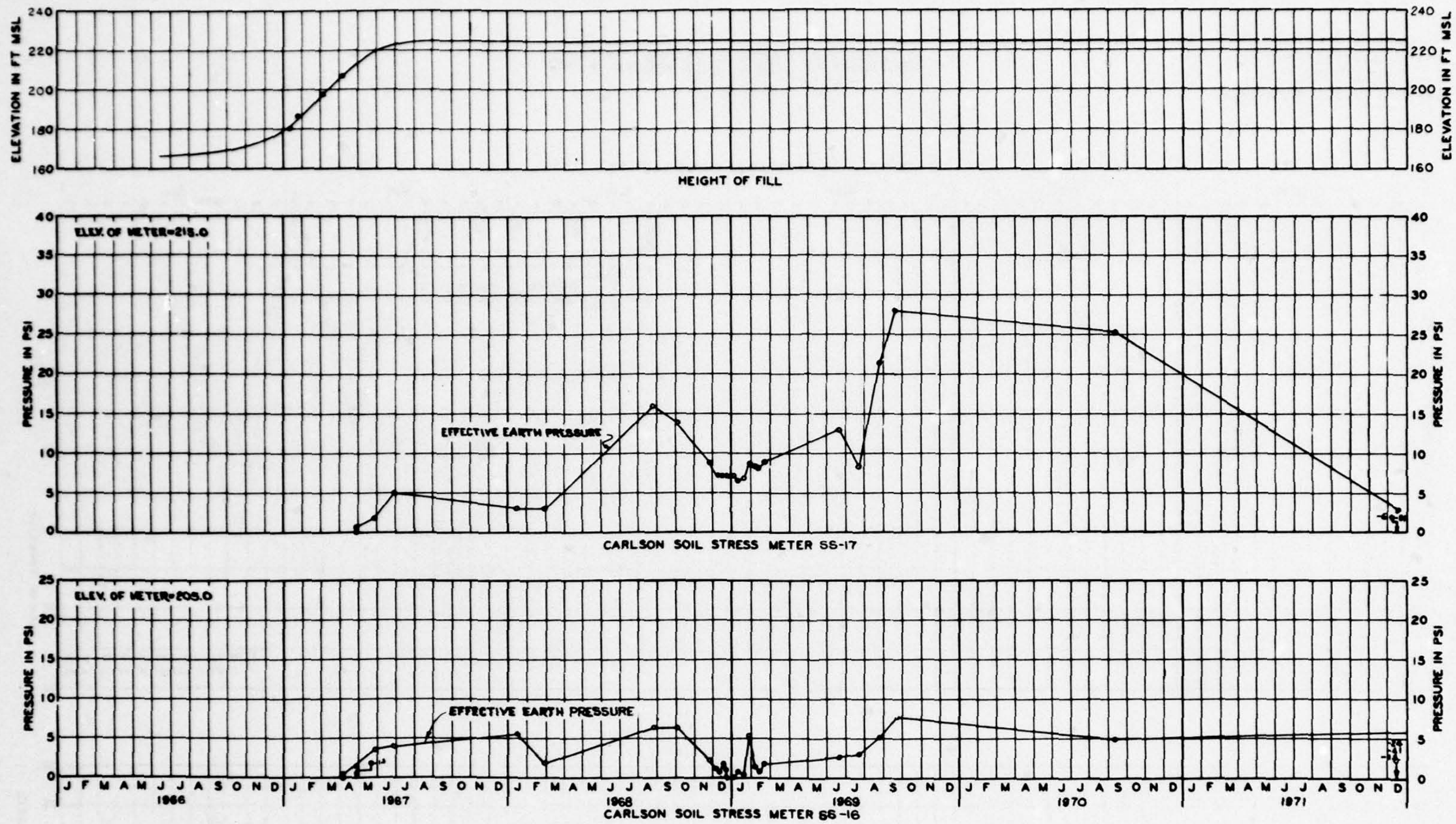
PLATE 52



DATA FROM SOIL STRESS METERS

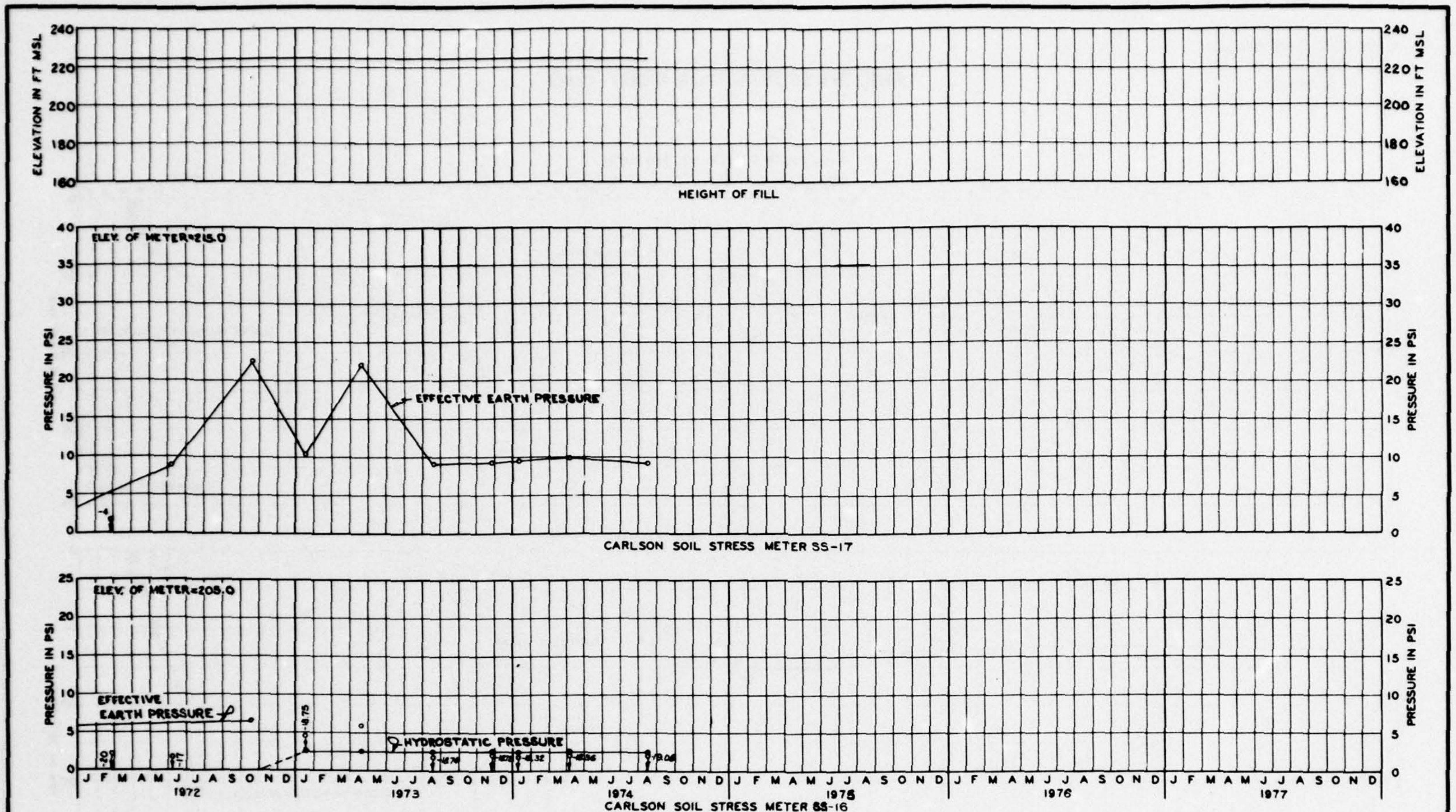
ARKANSAS LOCK AND DAM NO.5
MONOLITH 11
SOIL STRESS METER DATA
METERS SS-14 THRU SS-15

PLATE 54



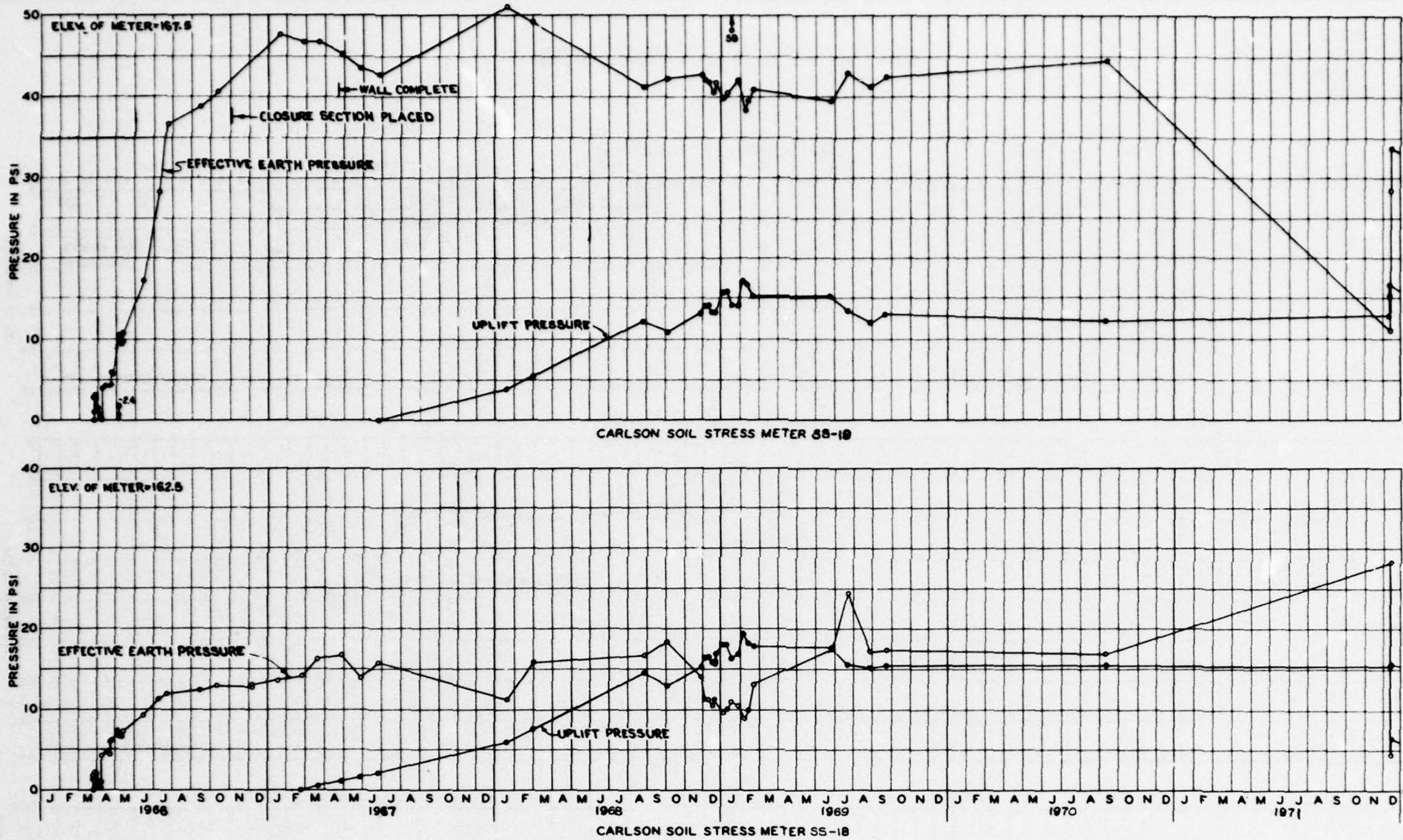
DATA FROM SOIL STRESS METERS

ARKANSAS LOCK AND DAM NO.5
MONOLITH 11
SOIL STRESS METER DATA
METERS SS-16 THRU SS-17



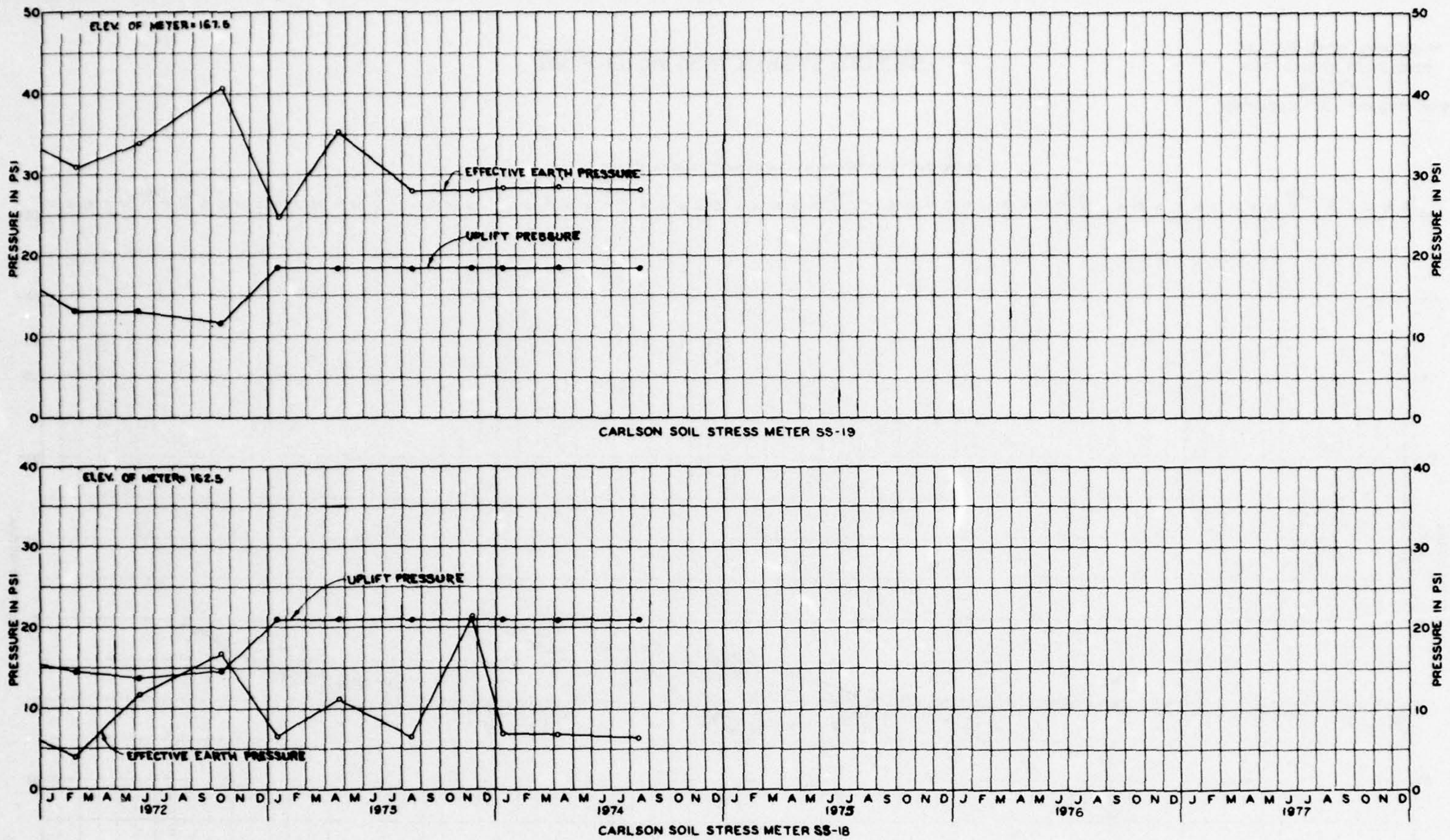
DATA FROM SOIL STRESS METERS

ARKANSAS LOCK AND DAM NO. 5
MONOLITH 11
SOIL STRESS METER DATA
METERS SS-16 THRU SS-17



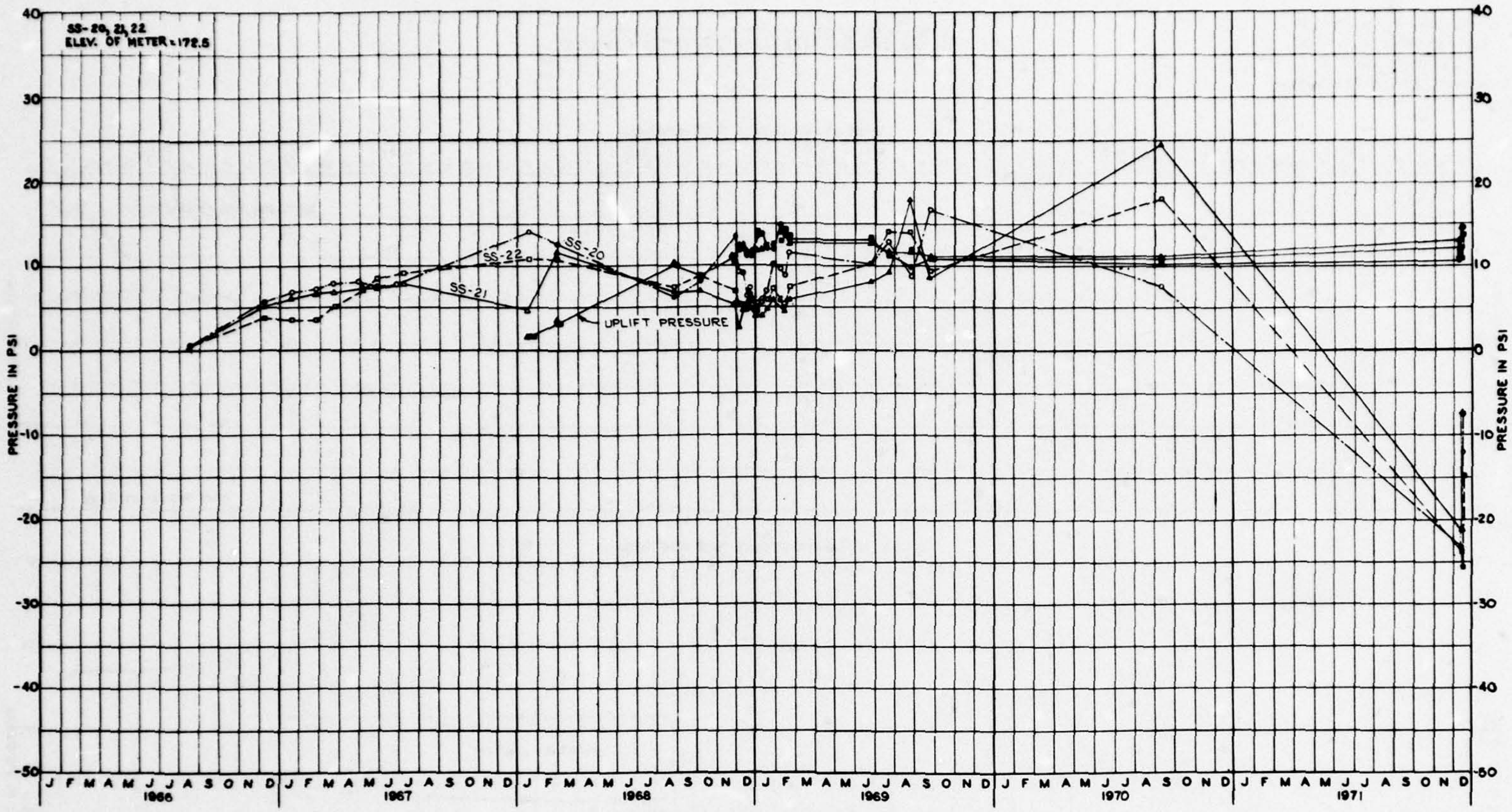
DATA FROM SOIL STRESS METERS

ARKANSAS LOCK AND DAM NO.5
MONOLITH 18
SOIL STRESS METER DATA
METERS SS-18 THRU SS-19



DATA FROM SOIL STRESS METERS

ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
SOIL STRESS METER DATA
METERS SS-18 THRU SS-19

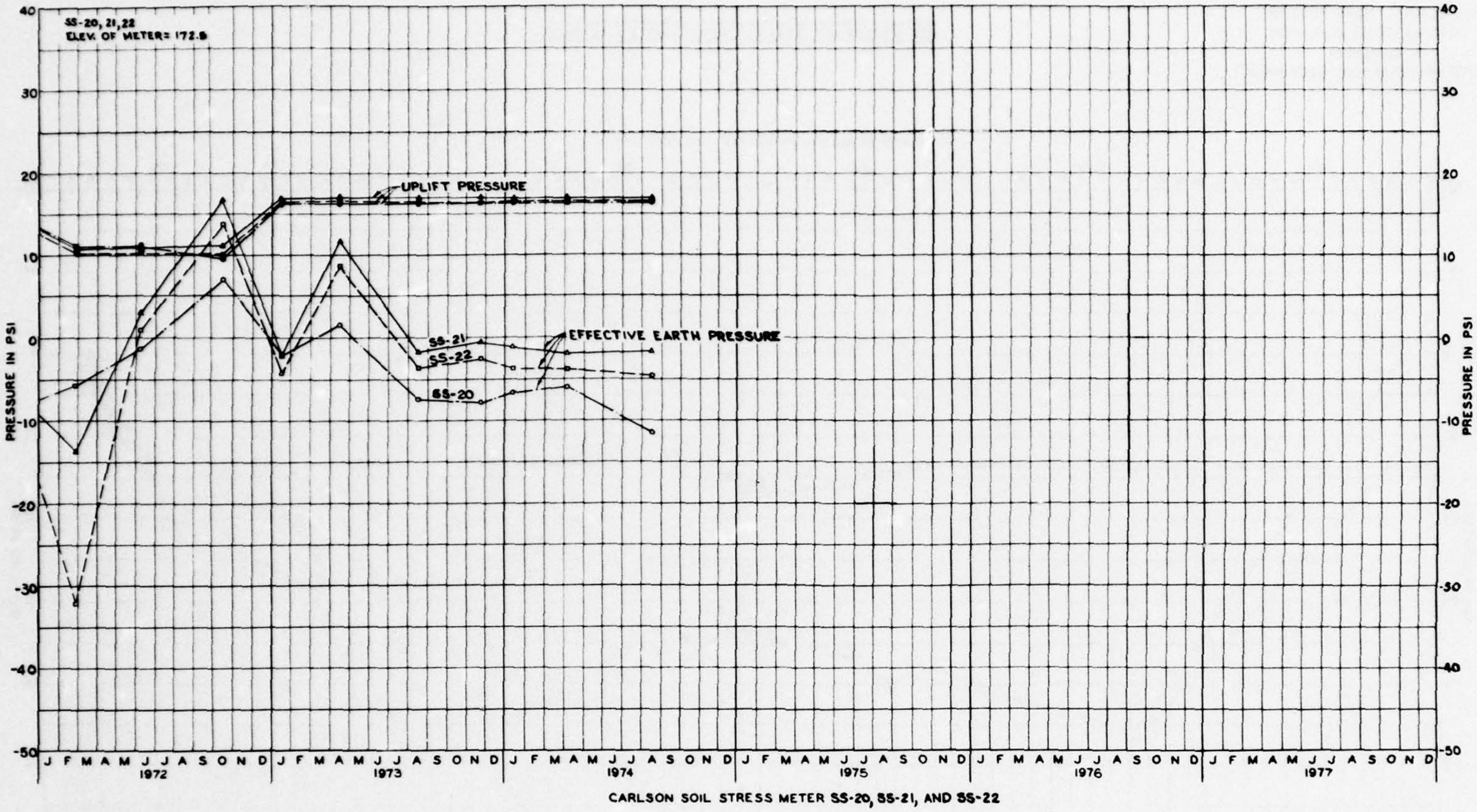


CARLSON SOIL STRESS METER SS-20, SS-21, AND SS-22

DATA FROM SOIL STRESS METERS

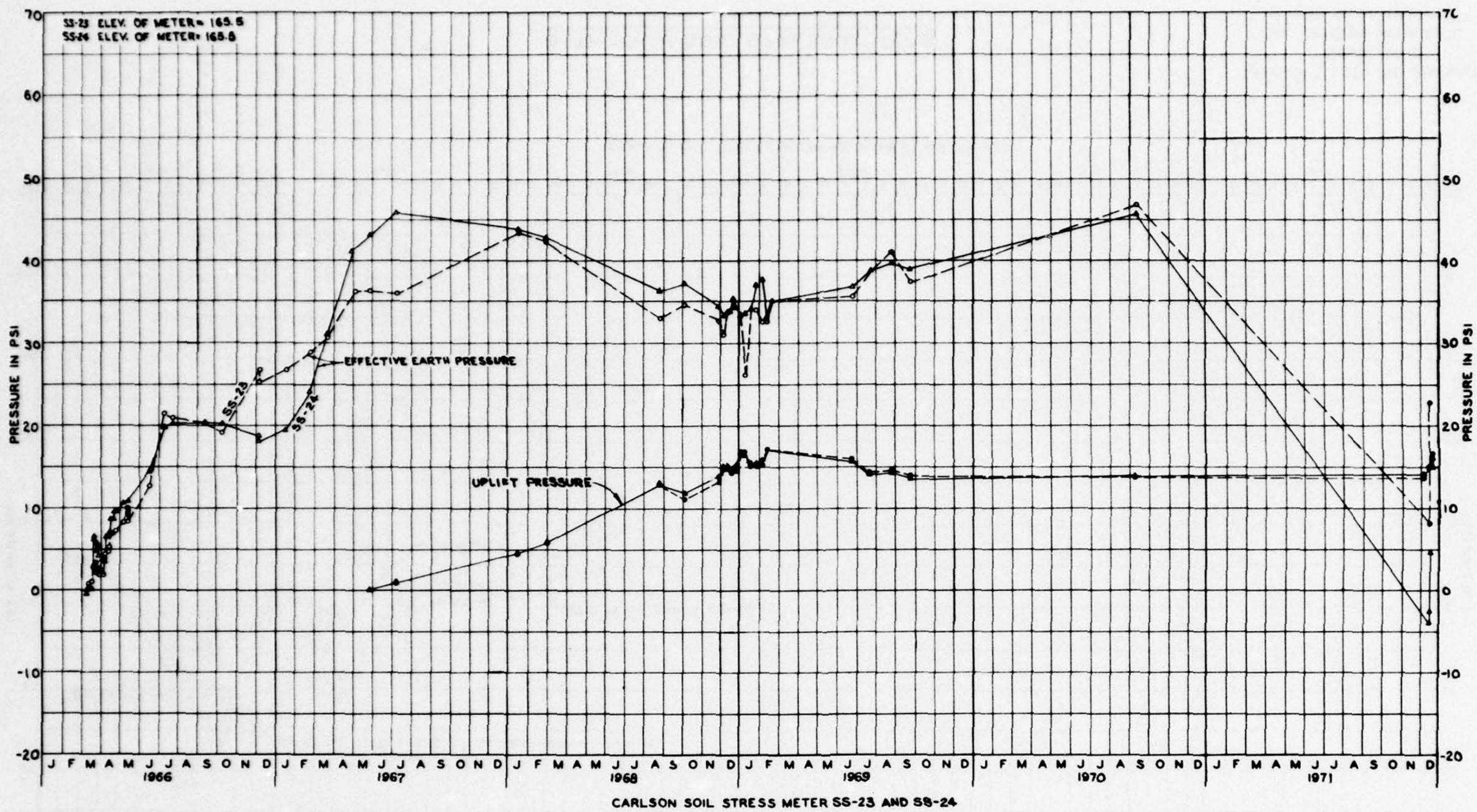
ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
SOIL STRESS METER DATA
METERS SS-20 THRU SS-22

PLATE 58



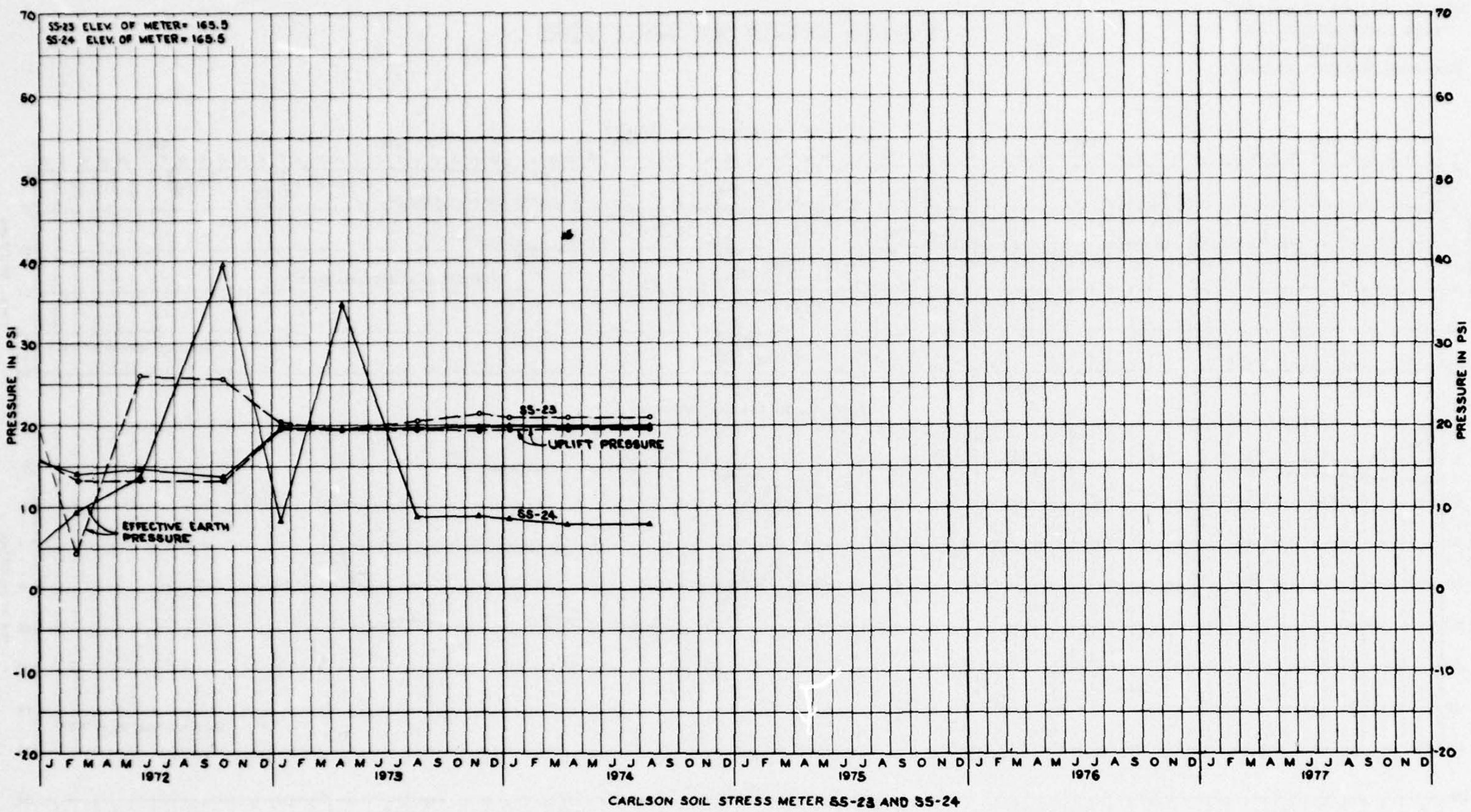
DATA FROM SOIL STRESS METERS

ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
SOIL STRESS METER DATA
METERS SS-20 THRU SS-22



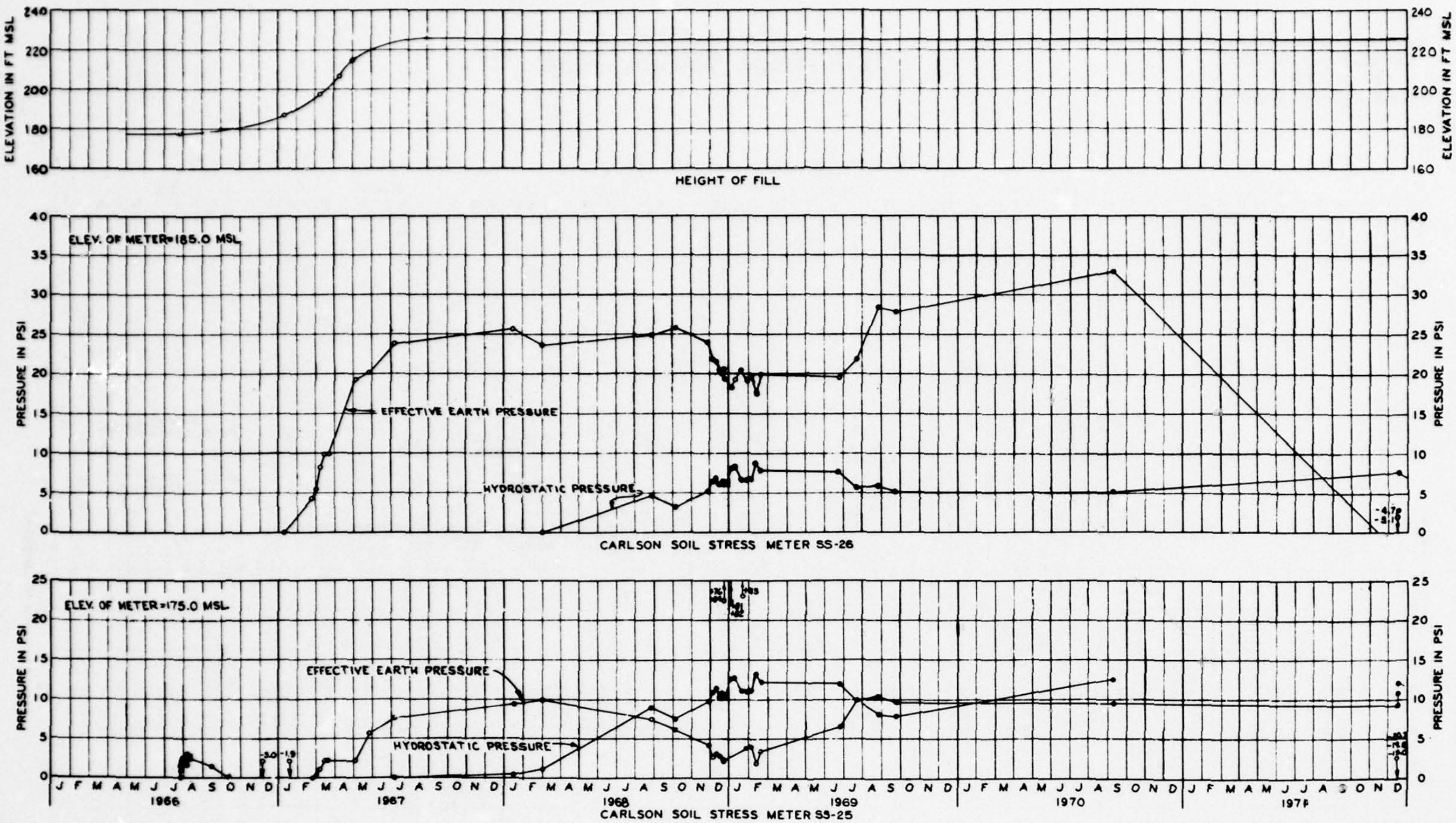
DATA FROM SOIL STRESS METERS

ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
SOIL STRESS METER DATA
METERS SS-23 THRU SS-24



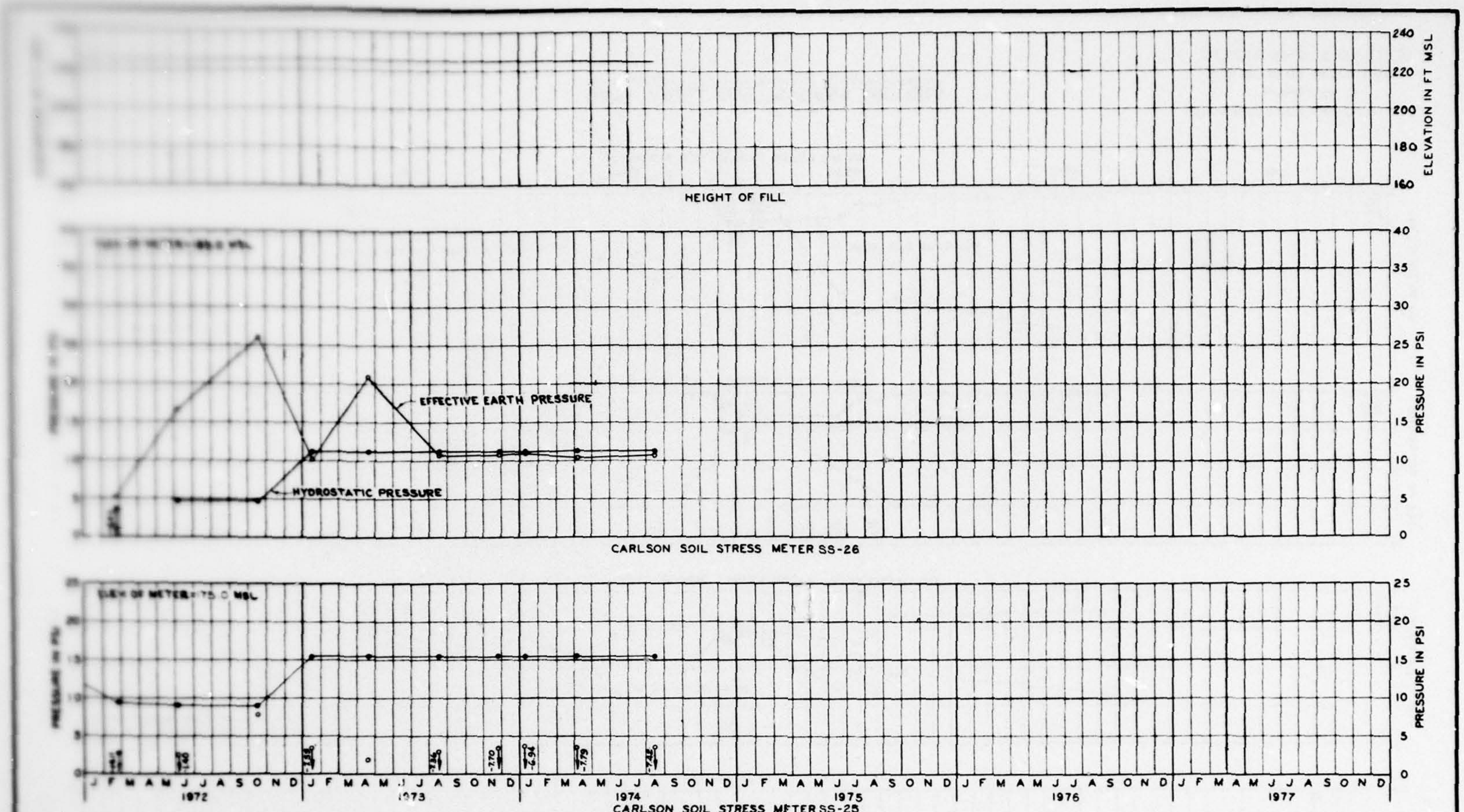
DATA FROM SOIL STRESS METERS

ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
SOIL STRESS METER DATA
METERS SS-23 THRU SS-24



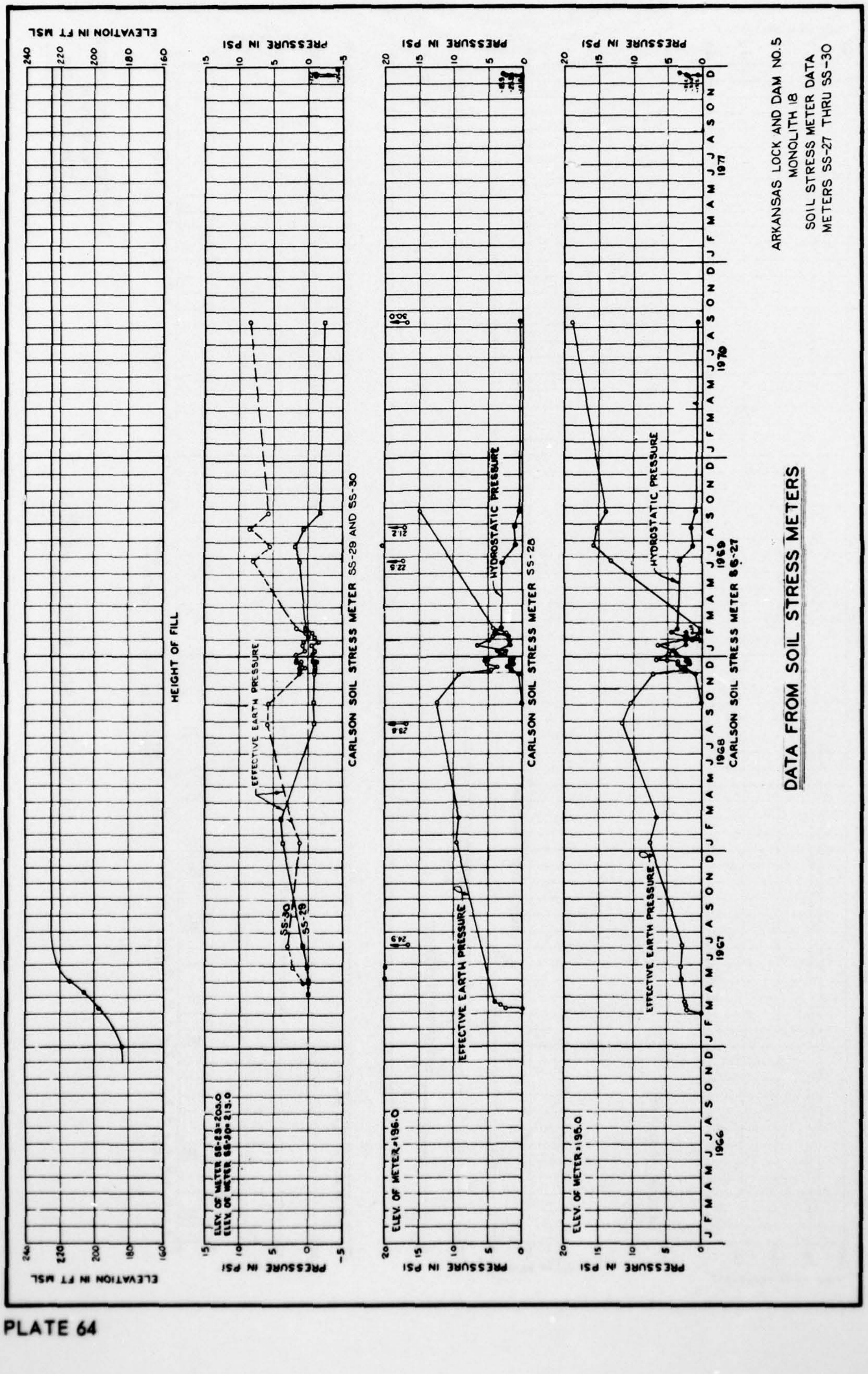
ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
SOIL STRESS METER DATA
METERS SS-25 THRU SS-26

DATA FROM SOIL STRESS METERS

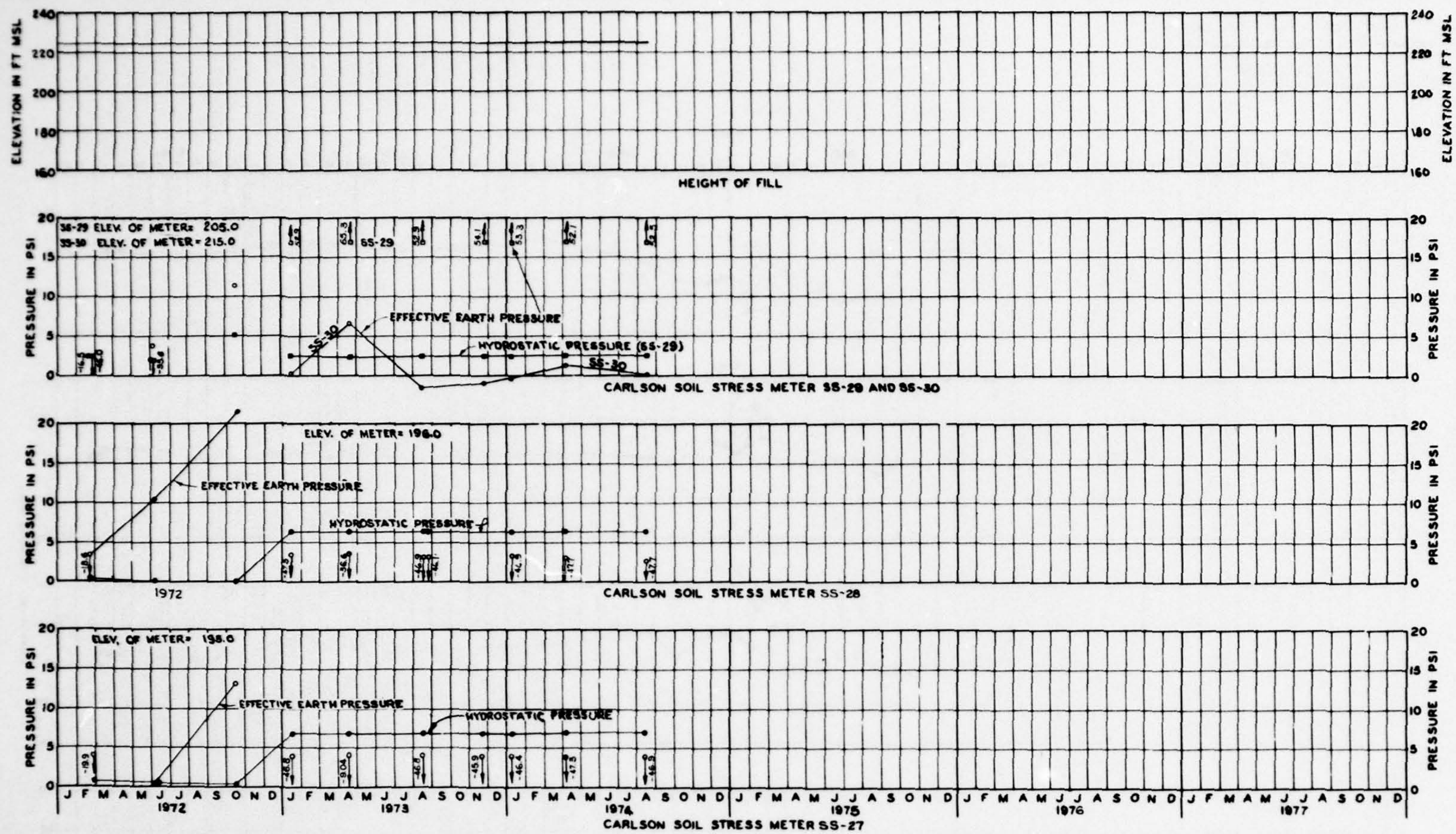


DATA FROM SOIL STRESS METERS

ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
SOIL STRESS METER DATA
METERS SS-25 THRU SS-26



HEIGHT OF FILL
ELEVATION IN FT MSL
ELEV. OF METER SS-29=203.0
ELEV. OF METER SS-30=213.0
EFFECTIVE EARTH PRESSURE
SS-30
SS-29
CARLSON SOIL STRESS METER SS-29 AND SS-30
PRESSURE IN PSI
ELEV. OF METER=196.0
EFFECTIVE EARTH PRESSURE
HYDROSTATIC PRESSURE
CARLSON SOIL STRESS METER SS-28
ELEV. OF METER=195.0
EFFECTIVE EARTH PRESSURE
HYDROSTATIC PRESSURE
CARLSON SOIL STRESS METER SS-27
J F M A M J J A S O N D
1966
1967
1968
1969
1970
1971
DATA FROM SOIL STRESS METERS
ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
SOIL STRESS METER DATA
METERS SS-27 THRU SS-30



ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
SOIL STRESS METER DATA
METERS SS-27 THRU SS-30

DATA FROM SOIL STRESS METERS

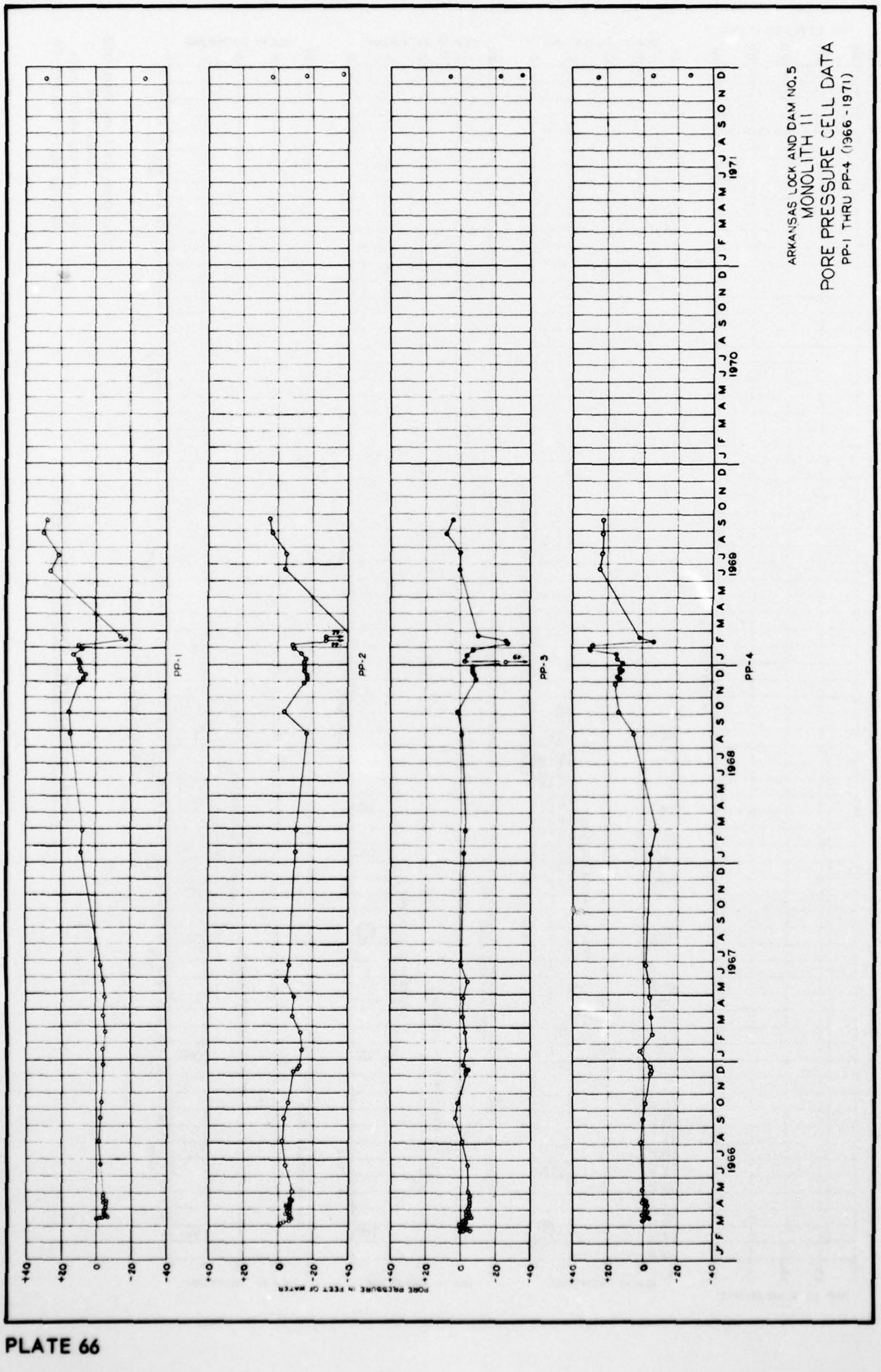

ARKANSAS LOCK AND DAM NO.5
MONOLITH 11
PORE PRESSURE CELL DATA
PP-1 THRU PP-4 (1966-1971)
PP-1
PP-2
PP-3
PP-4
PORE PRESSURE IN FEET OF WATER
+40
+20
0
-20
-40
1966
1967
1968
1969
1970
1971

PLATE 66

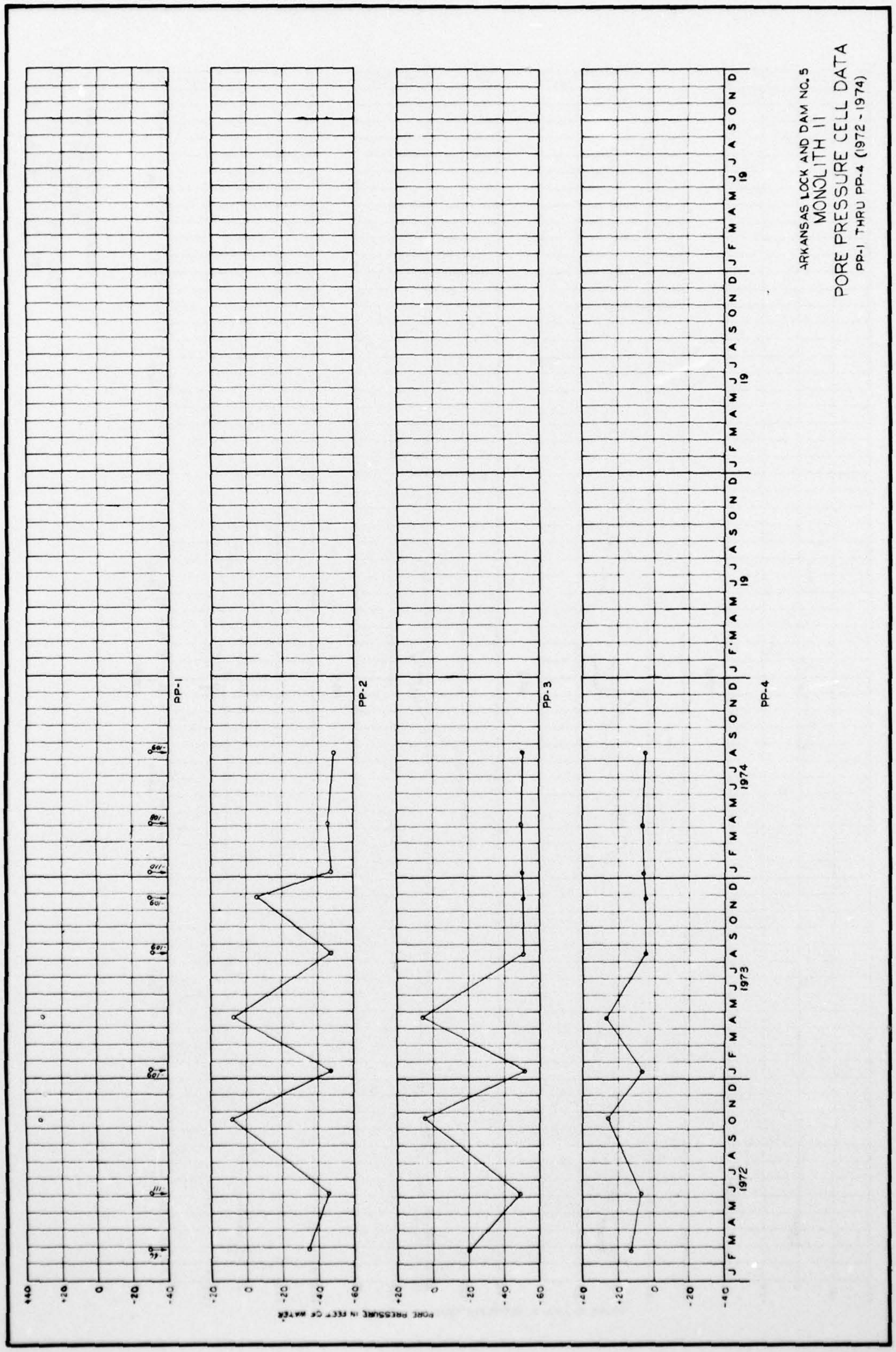
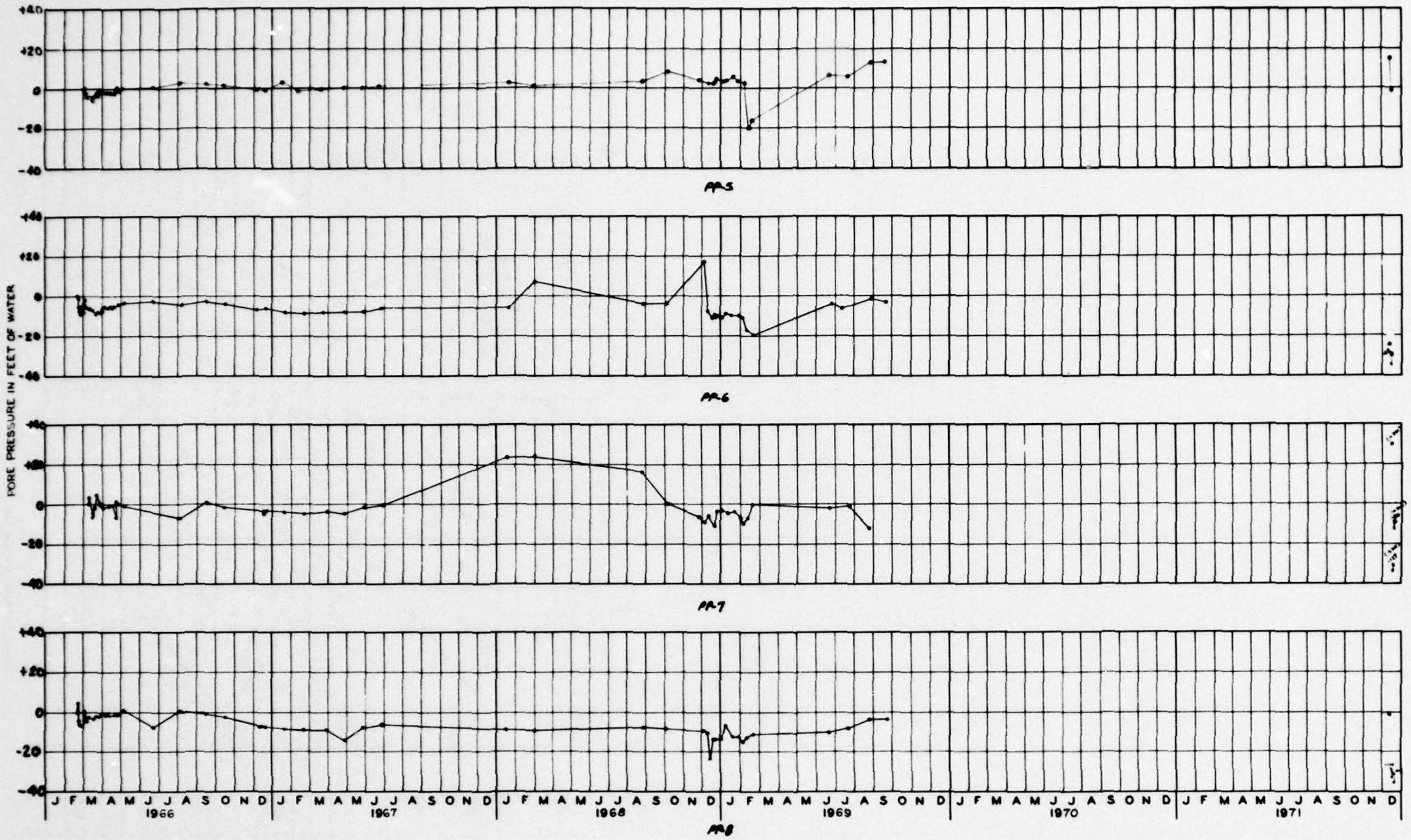
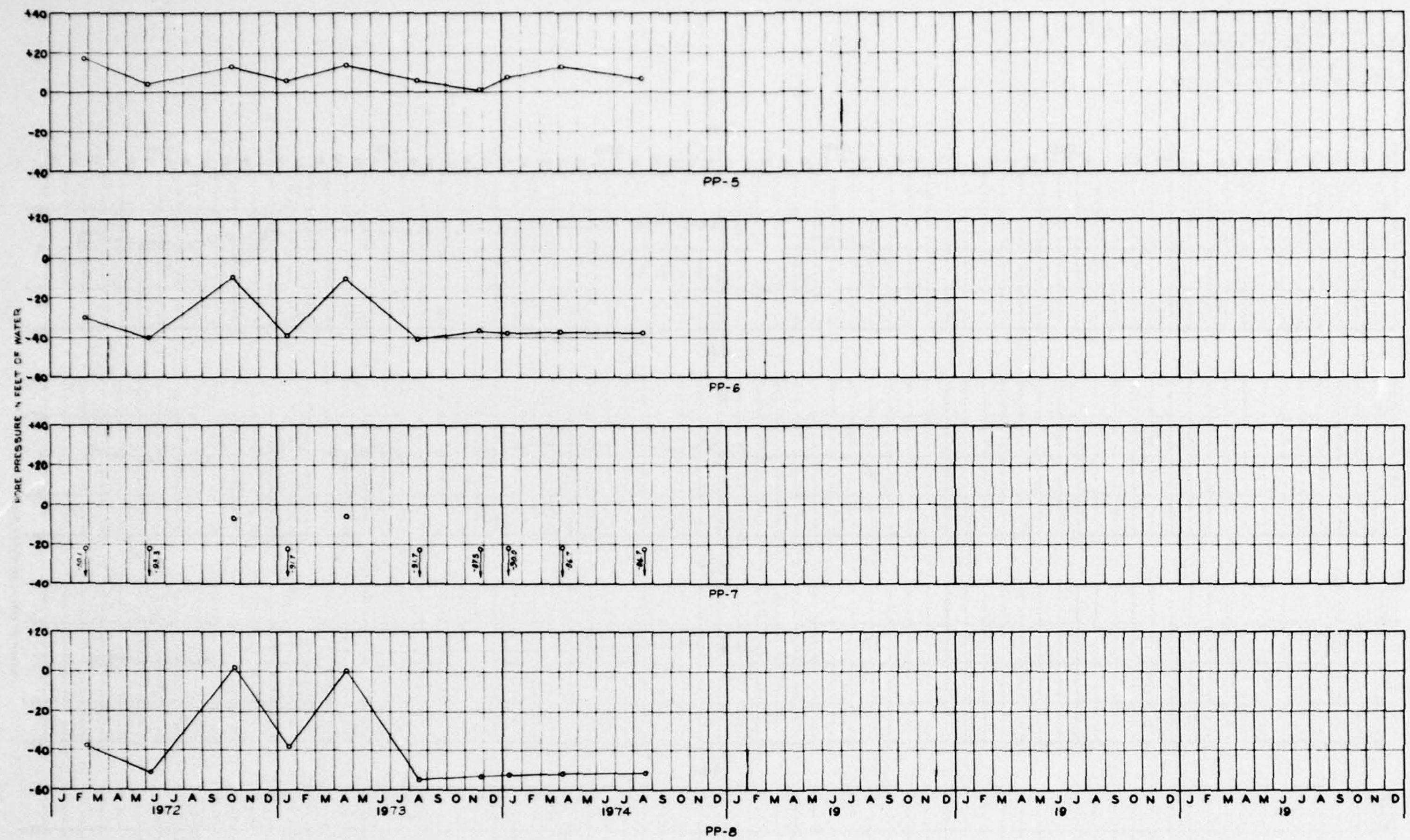

ARKANSAS LOCK AND DAM NO. 5
MONOLITH 11
PORE PRESSURE CELL DATA
PP-1 THRU PP-4 (1972 - 1974)
PP-1
PP-2
PP-3
PP-4
PORE PRESSURE IN FEET OF WATER
1972
1973
1974
19
19
19

PLATE 67



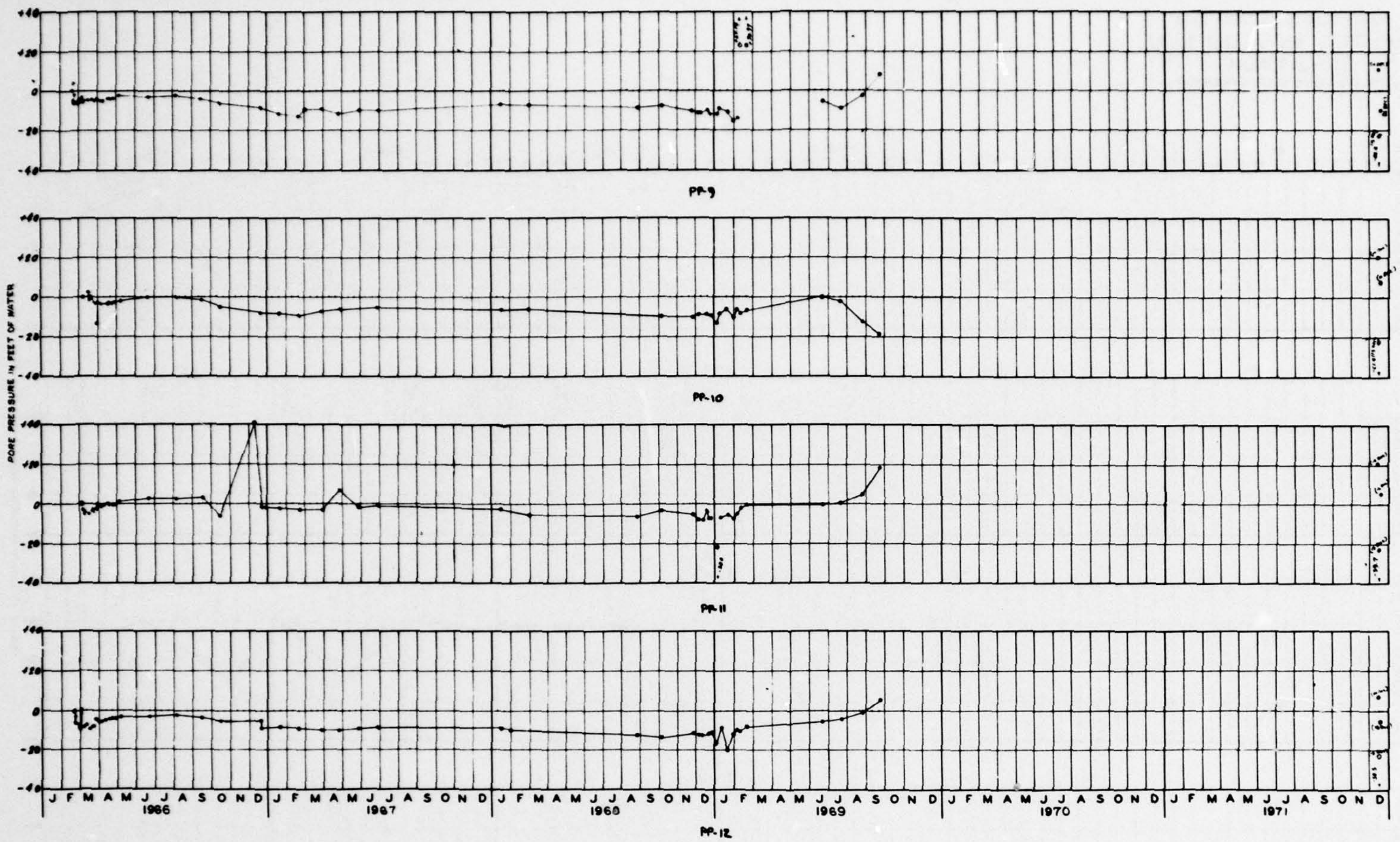
ARKANSAS LOCK AND DAM NO. 5
MONOLITH 11
PORE PRESSURE CELL DATA
PP-5 THRU PP-8 (1966 - 1971)

PLATE 68



ARKANSAS LOCK AND DAM NO. 5
MONOLITH 11
PORE PRESSURE CELL DATA
PP-5 THRU PP-8 (1972 - 1974)

PLATE 69



ARKANSAS LOCK AND DAM NO. 5
MONOLITH 11
PORE PRESSURE CELL DATA
PP-9 THRU PP-12 (1966 - 1971)

PLATE 70

ARKANSAS LOCK AND DAM NO. 5
MONOLITH 11
PORE PRESSURE CELL DATA
PP-9 THRU PP-12 (1972 - 1974)

PLATE 71

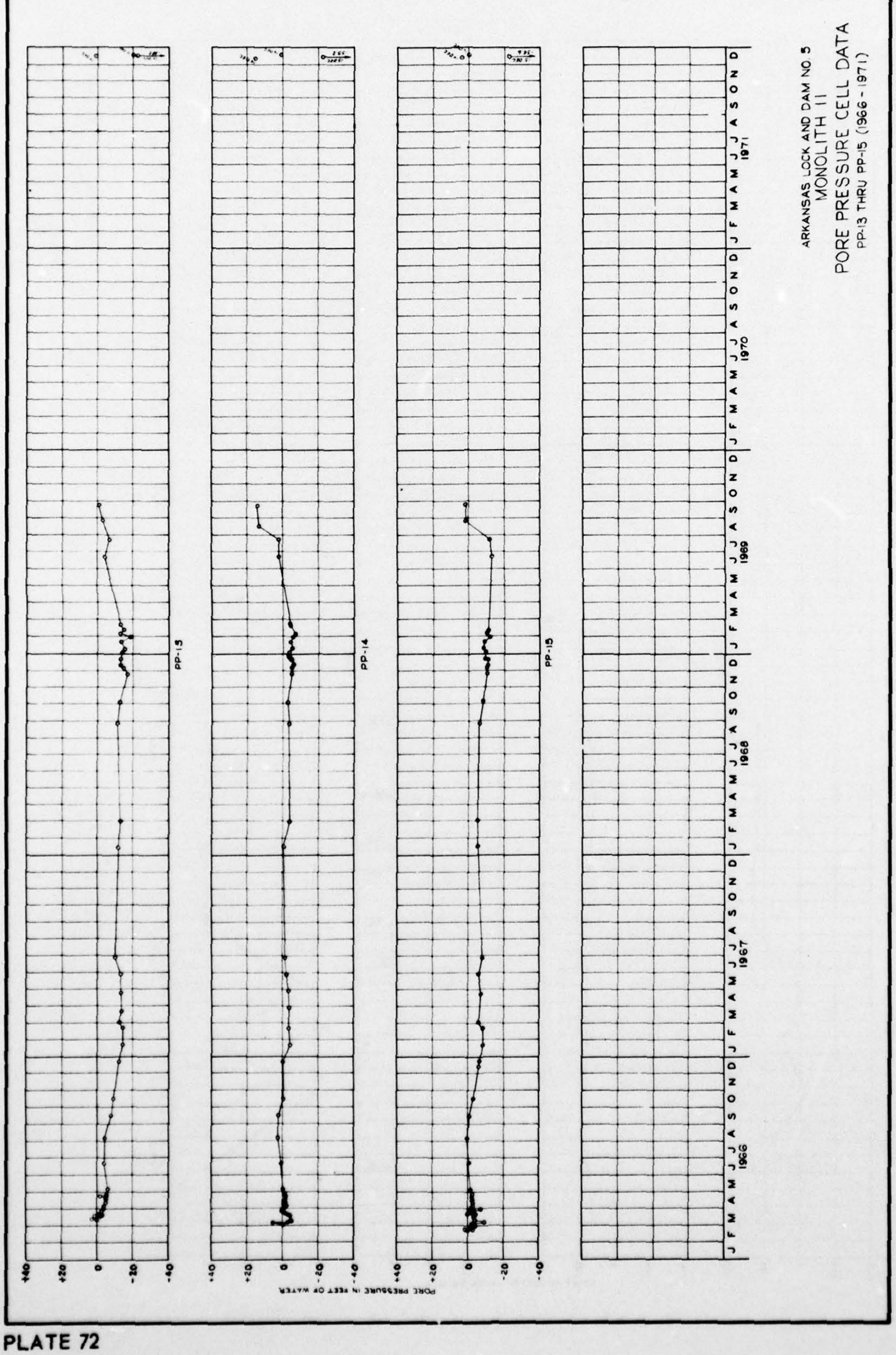

ARKANSAS LOCK AND DAM NO. 5
MONOLITH 11
PORE PRESSURE CELL DATA
PP-13 THRU PP-15 (1966 - 1971)
PP-13
PP-14
PP-15
PORE PRESSURE IN FEET OF WATER
+40
+20
0
-20
-40
J F M A M J J A S O N D
1966
1967
1968
1969
1970
1971

PLATE 72

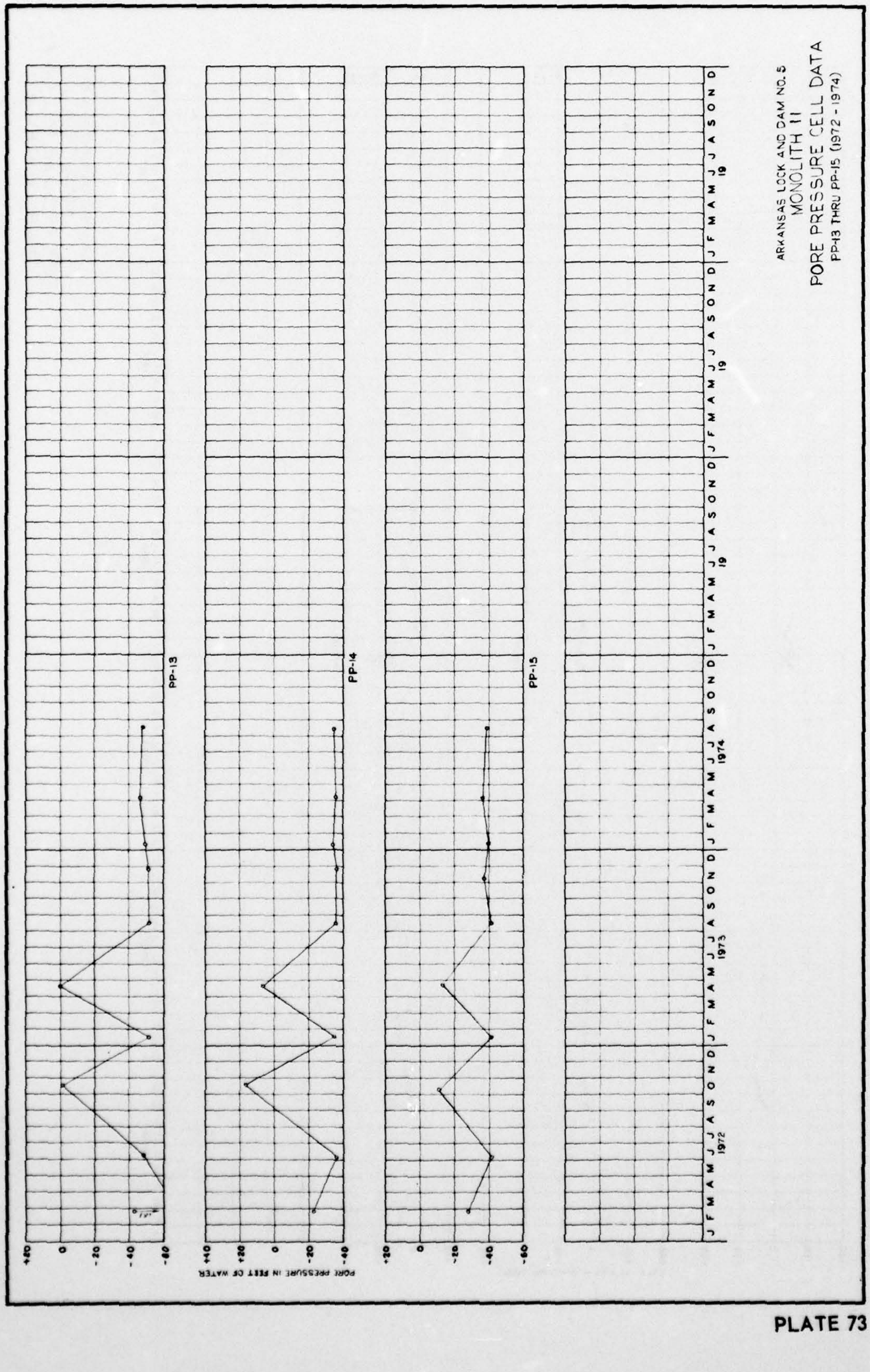
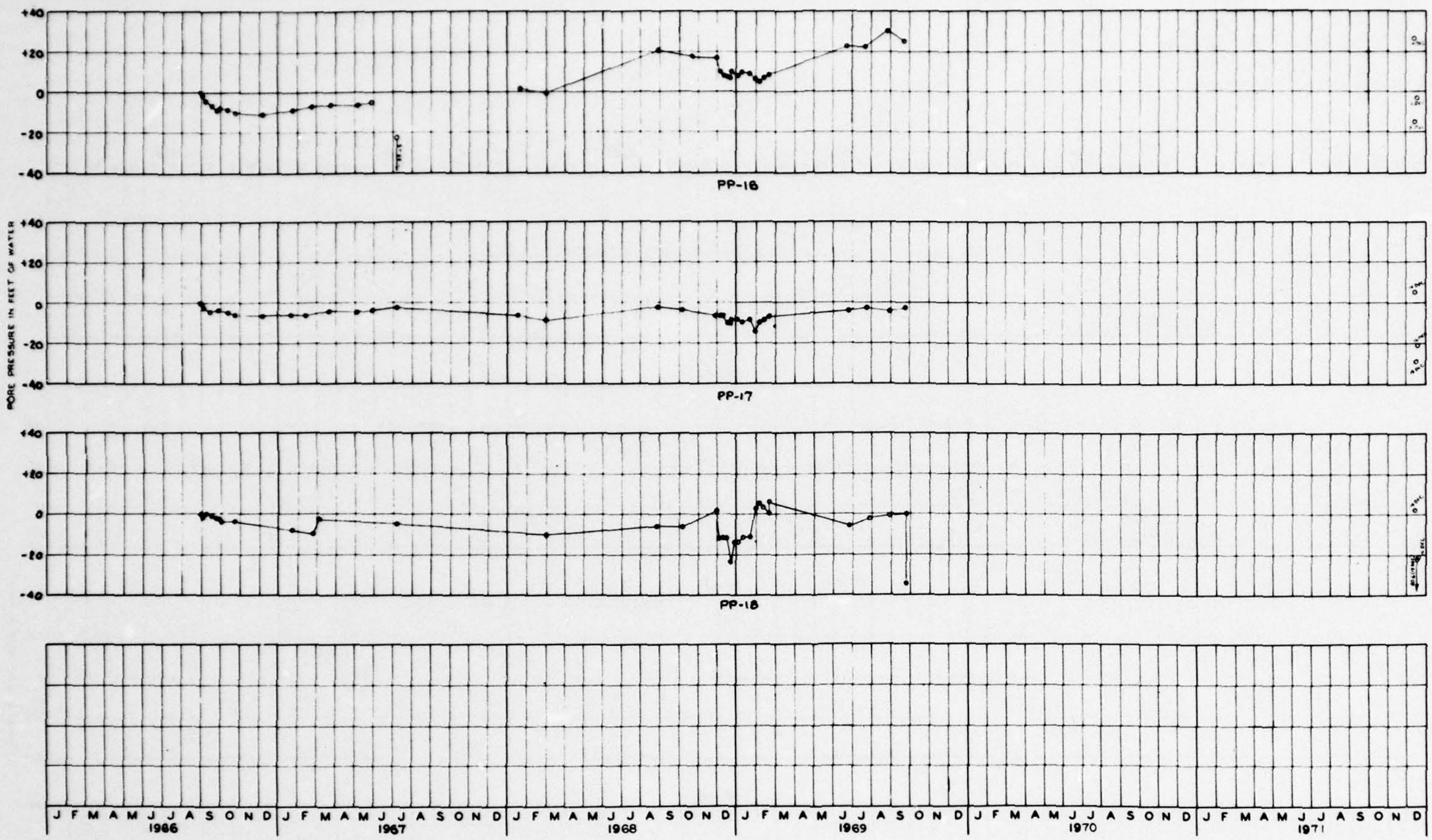
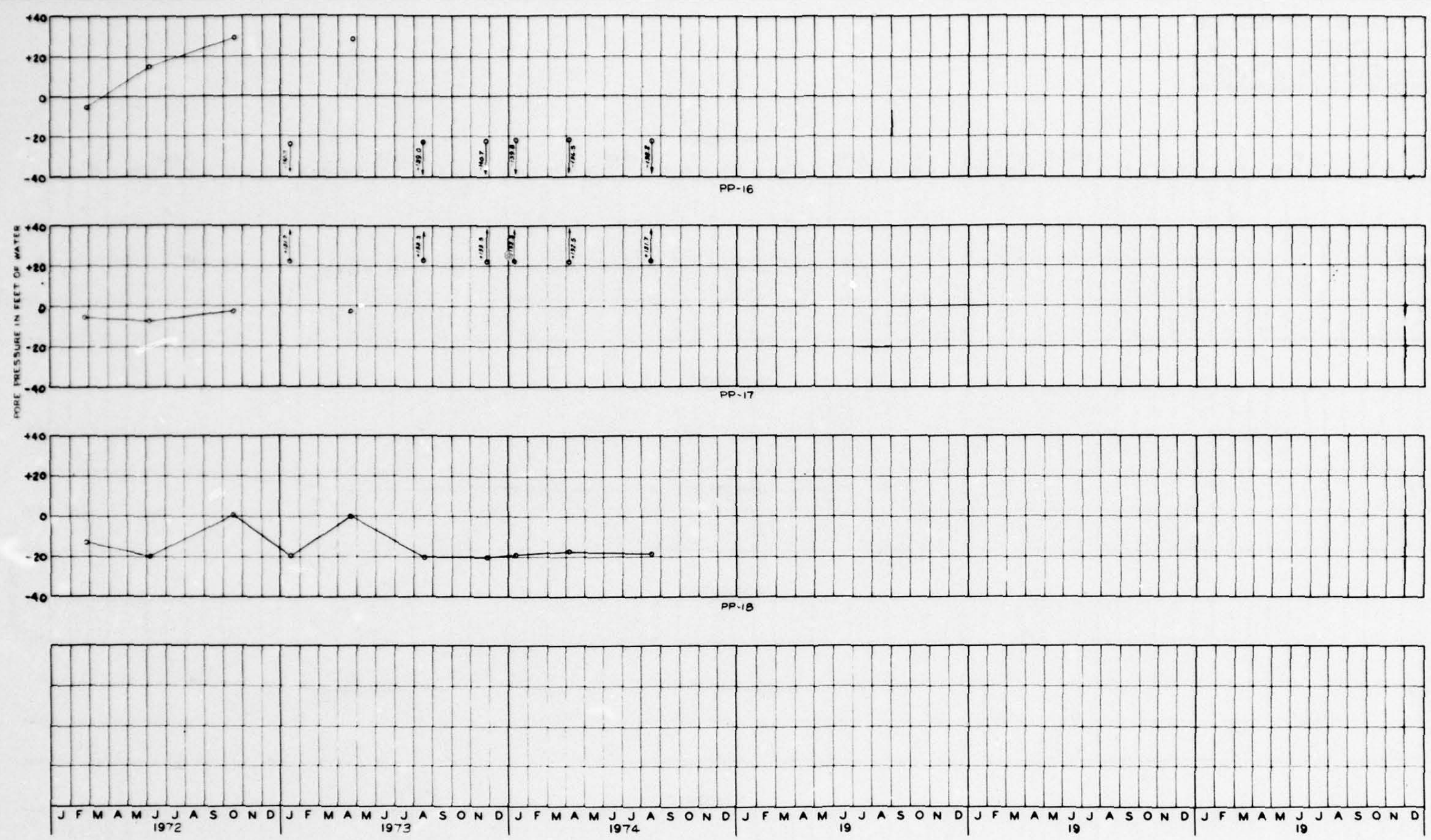

ARKANSAS LOCK AND DAM NO. 5
MONOLITH 11
PORE PRESSURE CELL DATA
PP-13 THRU PP-15 (1972 - 1974)
PP-13
PP-14
PP-15
PORE PRESSURE IN FEET OF WATER
J F M A M J J A S O N D
1972
1973
1974
19

PLATE 73



ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
PORE PRESSURE CELL DATA
PP-16 THRU PP-18 (1966 - 1971)



ARKANSAS LOCK AND DAM NO. 5
MONOLITH 18
PORE PRESSURE CELL DATA
PP-16 THRU PP-18 (1972 - 1974)

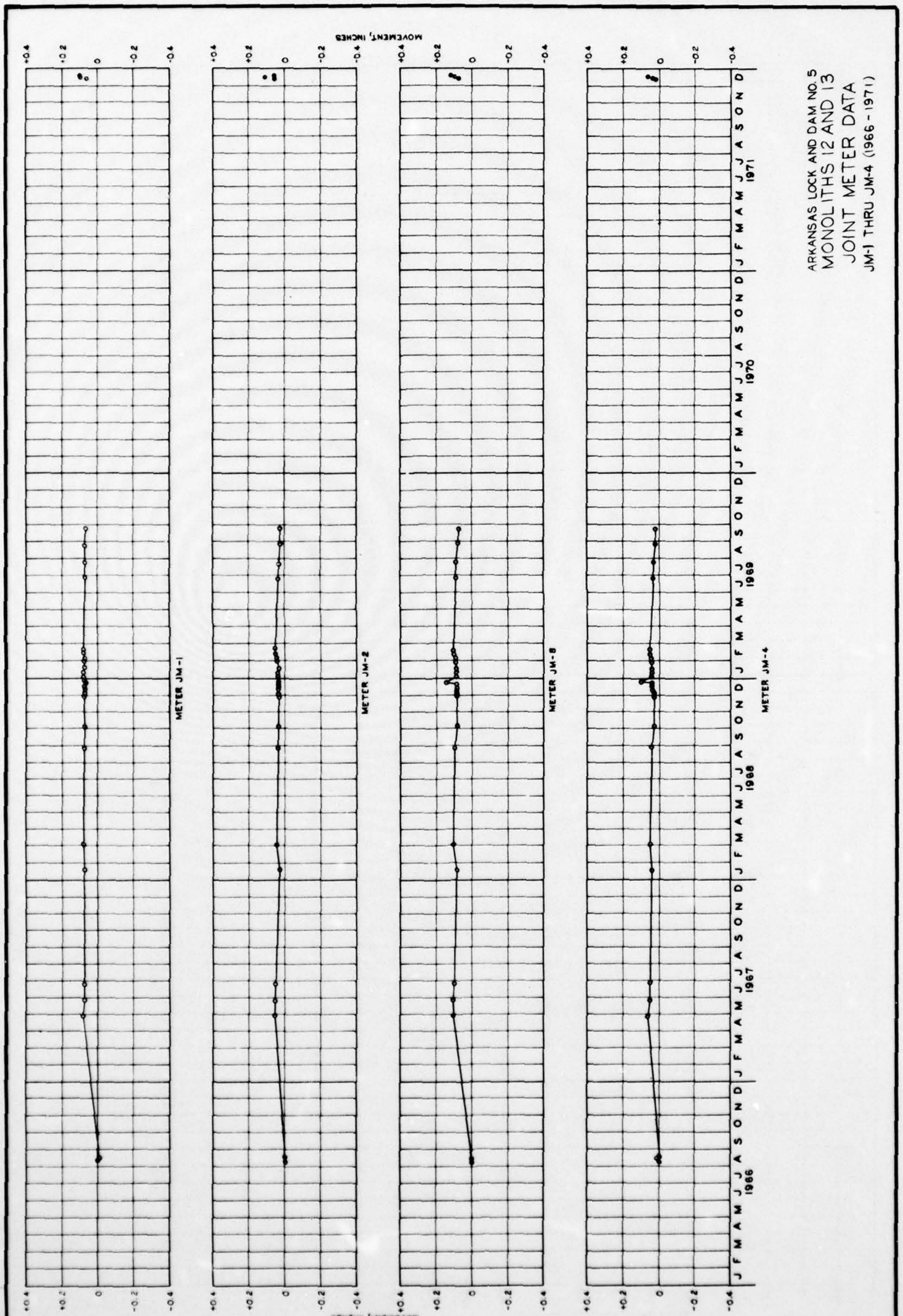
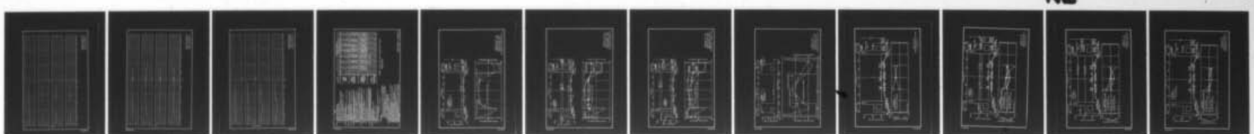

ARKANSAS LOCK AND DAM NO. 5
MONOLITHS 12 AND 13
JOINT METER DATA
JM-1 THRU JM-4 (1966-1971)
MOVEMENT, INCHES
METER JM-1
METER JM-2
METER JM-3
METER JM-4
1966
1967
1968
1969
1970
1971

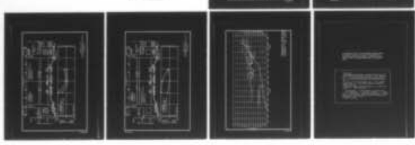
PLATE 76

AD-A061 073 ARMY ENGINEER WATERWAYS EXPERIMEN' STATION VICKSBURG MISS F/G 13/2
INSTRUMENTATION OBSERVATIONS FROM THE U-FRAME LOCK OF THE ARKAN--ETC(U)
AUG 78 R E LEACH

UNCLASSIFIED WES-MP-S-78-11 NL

2 OF 2
AD
A061073





END
DATE
FILMED
1 -79
DDC

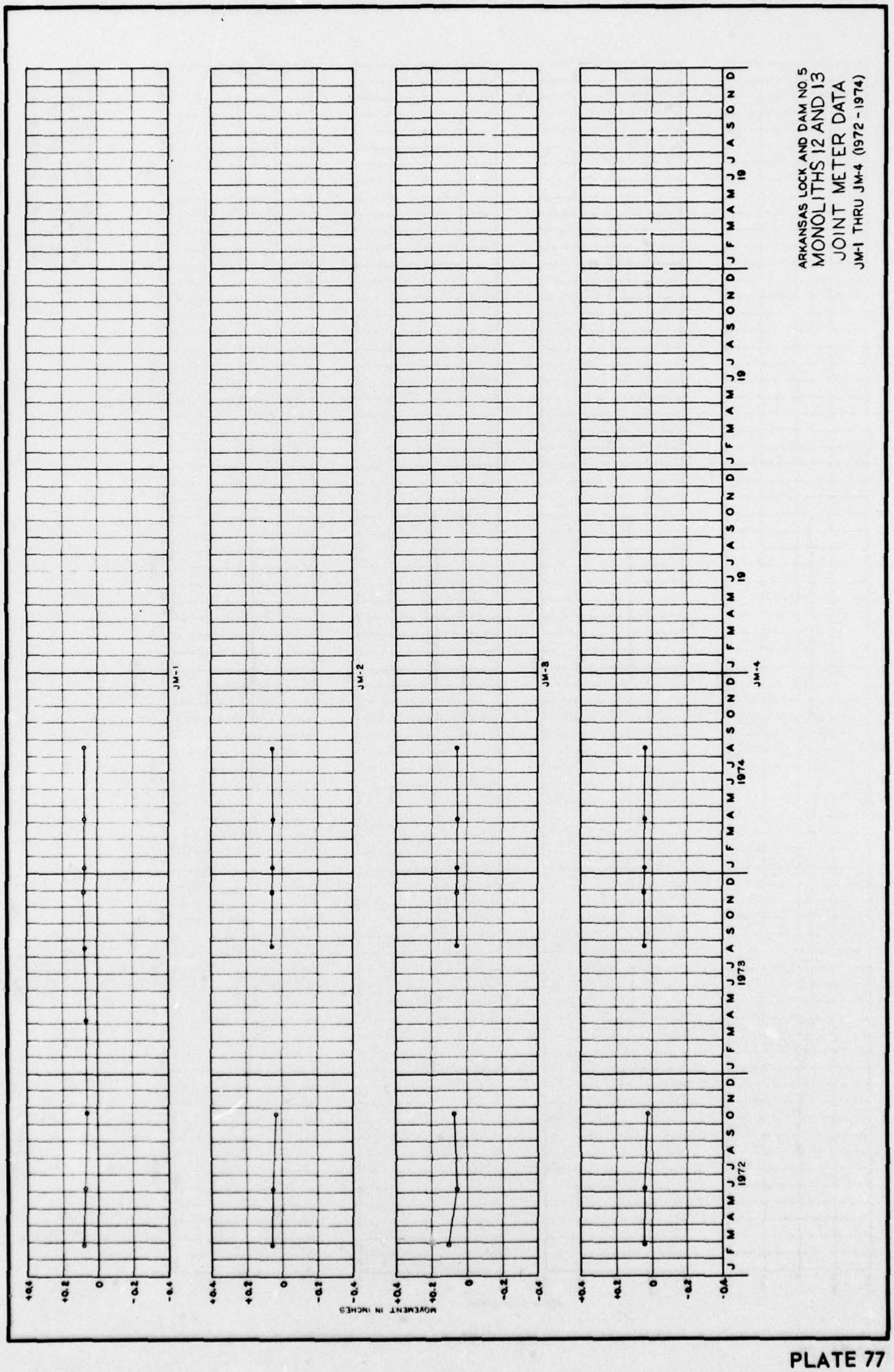

ARKANSAS LOCK AND DAM NO 5
MONOLITHS 12 AND 13
JOINT METER DATA
JM-1 THRU JM-4 (1972 - 1974)
MOVEMENT IN INCHES
JM-1
JM-2
JM-3
JM-4
1972
1973
1974

PLATE 77

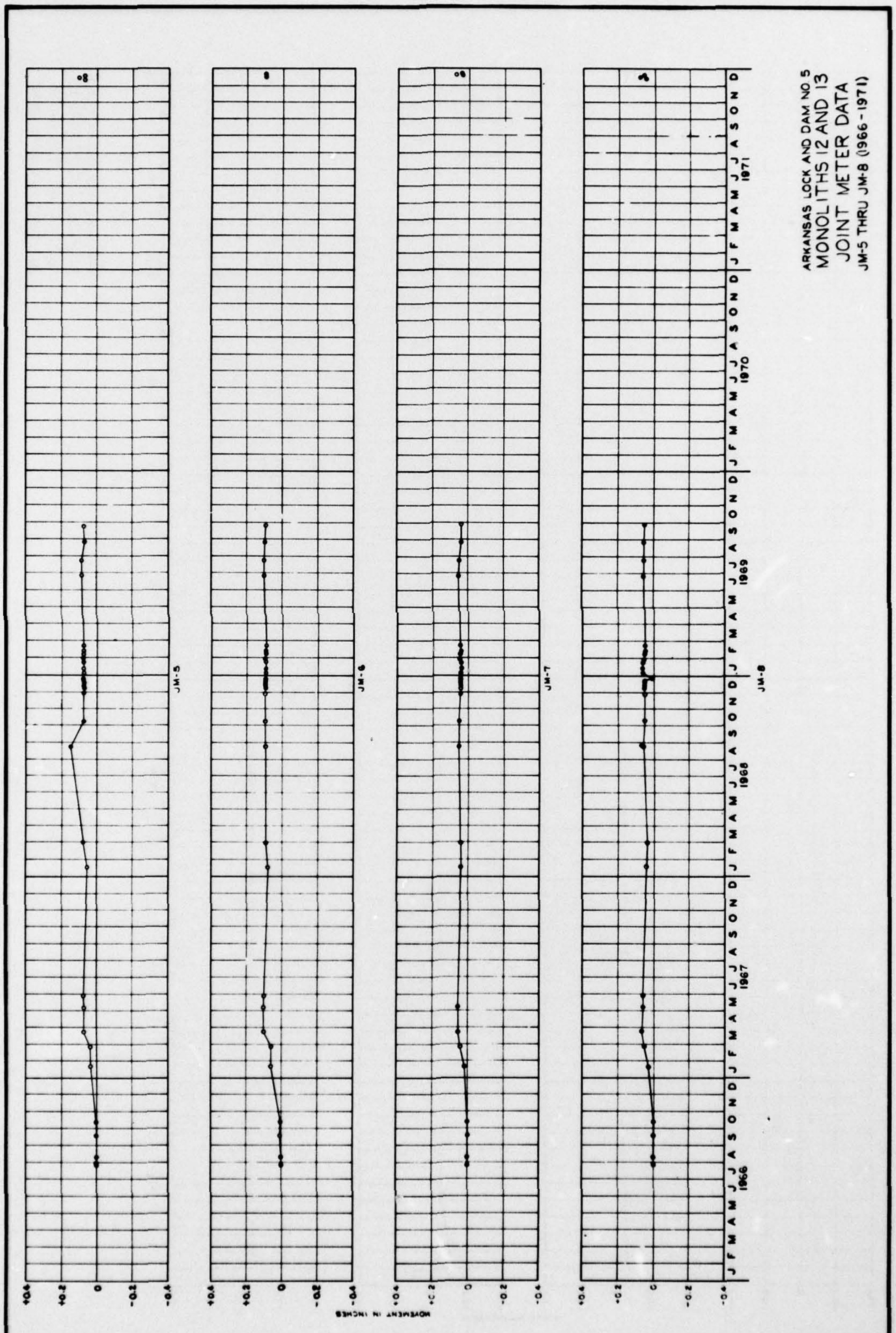

ARKANSAS LOCK AND DAM NO 5
MONOLITHS 12 AND 13
JOINT METER DATA
JM-5 THRU JM-8 (1966-1971)
JM-5
JM-6
JM-7
JM-8
MOVEMENT IN INCHES
1966
1967
1968
1969
1970
1971

PLATE 78

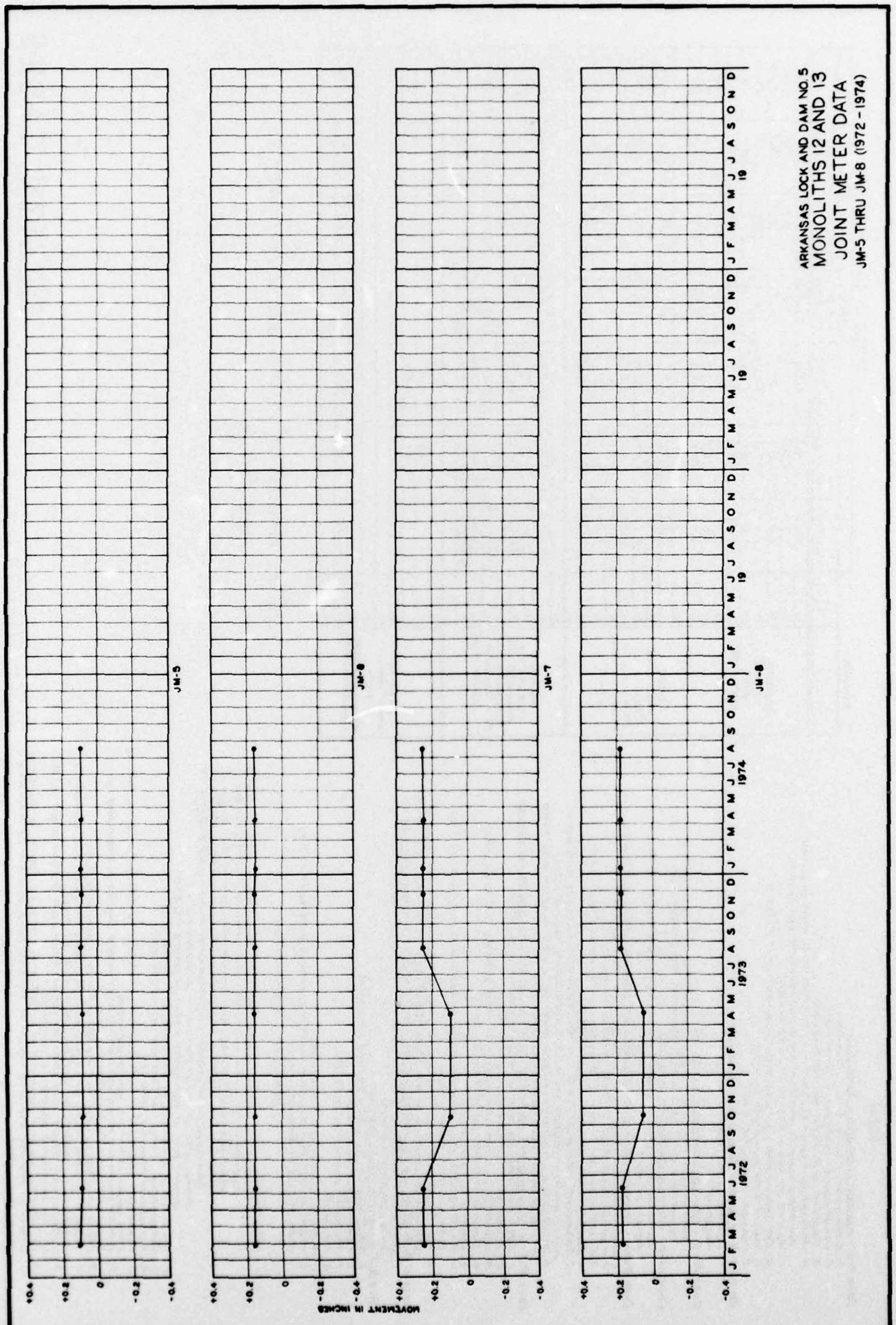

ARKANSAS LOCK AND DAM NO. 5
MONOLITHS 12 AND 13
JOINT METER DATA
JM-5 THRU JM-8 (1972-1974)
JM-5
JM-6
JM-7
JM-8
MOVEMENT IN INCHES
+0.4
+0.2
0
-0.2
-0.4
J F M A M J J A S O N D
1972
1973
1974
19

PLATE 80

CASES

Case I-a - Normal Operating Condition
1. Lower pool El. 196.0 in lock chamber.
2. Lower pool El. 196.0 behind riverwall.
3. Backfill to El. 225.0 behind landwall.
4. Saturation line at El. 204.5. K = 1.0 for 10.0', then constant earth pressure to depth where earth pressure corresponds to K = 0.35, then K = 0.35 to base of wall.
5. Fill behind riverwall assumed scoured out to El. 168.0.
6. Uplift over complete section.
7. Hawser load at El. 225.0.

Case I-b - Normal Operating Condition
Same as Case I-a, except K = 0.3 for earth pressures on entire height of wall.

Case IA-a - Normal Operating Condition
Same as Case I-a, except upper Pool El. 213.0 in lock chamber. Impact load at El. 218.0 in lock chamber. No hawser load.

Case IA-b - Normal Operating Condition
Same as Case IA-a, except K = 0.3 for earth pressures on entire height of wall.

Case II C-a - Extreme Maintenance Condition - Normal Design Stresses
1. Lock Chamber dewatered to top of floor slab El. 179.0.
2. Normal lower pool El. 198.0 behind riverwall.
3. Backfill behind riverwall assumed scoured out to El. 168.0.
4. Backfill behind landwall at El. 225.0.
5. Saturation line at El. 204.5. K = 0.45 to 10.0', then constant earth pressure to intersect K = 0.35, then K = 0.35 to base of wall.
6. Uplift 100% at outside edges varying to slab haunch with head of 11.0' of water pressure (179.0 - 168.0).

Case II D-a - Extreme Maintenance Condition - One-third Overstress Design
1. Lock chamber dewatered to top of floor slab El. 179.0.
2. Lower pool El. 211.5 behind riverwall.
3. Backfill behind riverwall assumed scoured out to El. 168.0.
4. Backfill behind riverwall at El. 225.0.
5. Saturation line at 211.5.
6. K = 1.0 to 10.0', then constant earth pressure to intersect K = 0.35, then K = 0.35 to base of wall.
7. Uplift 100% at outside edges varying to slab haunch with head of 16.0' of water pressure across slab. (Top of slab, El. 179.0 plus 5.0', El. 184.0)

Case II D-b - Extreme Maintenance Condition Normal or 1/3 Overstress Design
Same as Case II D-a (1/3 overstress), Except K = 0.3 for earth pressures on entire height of wall.

Case III A-a - Construction Condition
1. Moist backfill to El. 225.0 behind landwall.
2. Construction complete.
3. Riverwall excavation to El. 168.0.
4. No Uplift.
5. Wind on inside face of riverwall.
6. K = 0.45 to 10.0', then constant earth pressure to intersect K = 0.35, then K = 0.35 to base of wall.

PERTINENT INFORMATION

1. Unit Weights
   - Water —— 62.5 lbs/cu ft
   - Concrete —— 150.0 lbs/cu ft
   - Moist sand backfill, compacted —— 115.0 lbs/cu ft
   - Saturated sand backfill, compacted —— 125.0 lbs/cu ft
   - Submerged sand backfill, compacted —— 62.5 lbs/cu ft

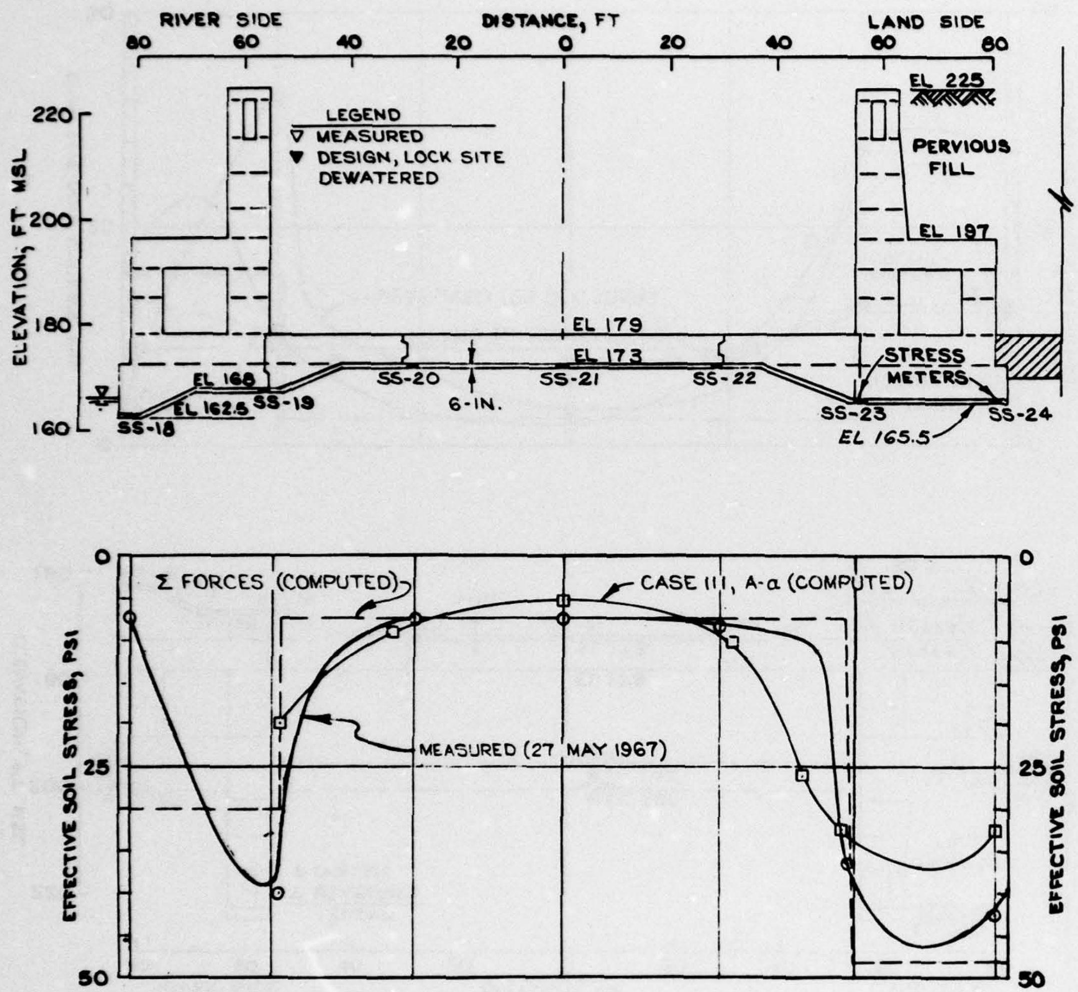
   Moment arm of horizontal earth pressure = 0.4H
   Moment arm of horizontal water pressure = 0.33H
2. Modulus of Elasticity of Concrete, E_c = 3,000,000 p.s.i.
3. Compressive Strength of Concrete, f'_c = 3000 p.s.i.
4. Foundation Modulus; 400 kcf.
5. Cases were also checked with foundation modulus of 800 kcf, and reinforcing steel varied 14% from tabulated values.
6. Tabular values are actual reinforcing steel areas required, analyzed by Beam on Elastic Foundation Method.
7. Main reinforcing steel will be 1.27 in.^{2} min.; top and bottom.
8. Beam on Elastic Foundation analysis is based on IBM 650 Computer analysis, furnished by Buffalo, New York District.
9. Construction cases were checked for vertical wall friction angle of 20°, but this was not a governing condition.
10. Reinforcing has been computed at x_1 = 8.7 sq. in., at x_6 = 3.7 sq. in., at x_7 = 4.0 sq. in. based on this and the soils report in the appendix, and will be reflected on contract plans.

TABLE OF CASE RESULTS

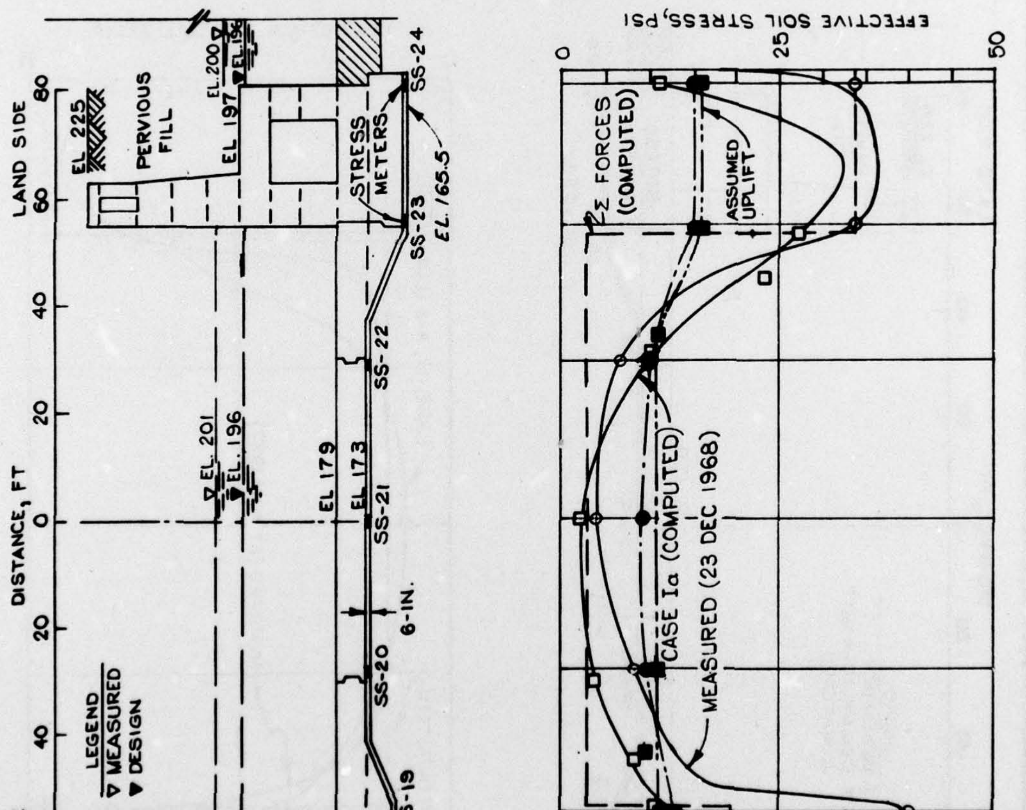
Monolith	$\bar{X}$ (ft)	Case I-b	Case IA-a	Case IA-b	Case II C-a (Normal)	Case II D-a (1/3 overstress)	Case II D-b (Normal)	Case III A-a
UNIFORMLY VARYING BASE PRESSURE (KSF)	x_0	1.05	1.87	1.74	1.22	1.17	1.07	1.82
	x_1	1.24	2.02	1.94	1.45	1.32	1.26	2.09
	x_2	1.31	2.07	2.01	1.53	1.38	1.32	2.19
	x_3	1.41	2.15	2.11	1.65	1.46	1.42	2.34
	x_4	1.61	2.31	2.32	1.90	1.62	1.62	2.63
	x_5	1.81	2.47	2.53	2.15	1.78	1.82	2.92
	x_6	1.91	2.55	2.63	2.27	1.87	1.92	3.07
	x_7	1.98	2.60	2.70	2.35	1.92	1.98	3.17
	x_8	2.17	2.76	2.90	2.58	2.07	2.17	3.45
BASE PRESSURE Computed by Beam on Elastic Foundation Method (KSF)	x_0							
	x_1	1.771	1.957	1.972	2.154	2.249	2.275	2.803
	x_2	1.226	1.425	1.462	1.702	1.881	1.926	2.093
	x_3	0.556	1.268	1.290	0.930	0.898	0.870	1.297
	x_4	0.221	1.341	1.363	0.157	0.104	0.127	0.927
	x_5	1.140	2.169	1.819	1.600	1.674	1.293	1.953
	x_6	2.699	3.478	2.824	3.371	3.763	3.058	3.793
	x_7	3.345	3.874	3.486	3.909	3.976	3.554	4.676
	x_8							4.985
MOMENT Computed by Beam on Elastic Foundation Method (+ = Tension in Bottom Face)	x_0							
	x_1	90.775	-117.477	-105.043	163.327	301.316	315.825	88.271
	x_2	-16.650	-73.529	-70.836	11.282	56.953	61.886	-30.177
	x_3	-37.696	-14.404	-15.558	-39.768	-49.218	-50.689	-46.211
	x_4	-15.806	-8.595	-1.333	-22.460	-36.861	-28.158	-16.458
	x_5	-83.160	-68.169	-59.365	-90.303	-97.445	-88.074	-100.674
	x_6	69.535	83.504	2.952	112.458	205.132	117.606	61.790
	x_7	432.521	414.033	199.480	556.078	794.990	561.831	471.597
	x_8							
AREA OF Reinf. steel (in^2) Beam on elastic foundation method	x_0							
	x_1		0.44	0.51				
	x_2		0.47	0.59				
	x_3							
	x_4							
	x_5							
	x_6							
	x_7	1.15	1.15	0.44	1.30	1.60	0.80	1.50
	x_8							

NOTE: Areas of reinf. steel not were negligible.

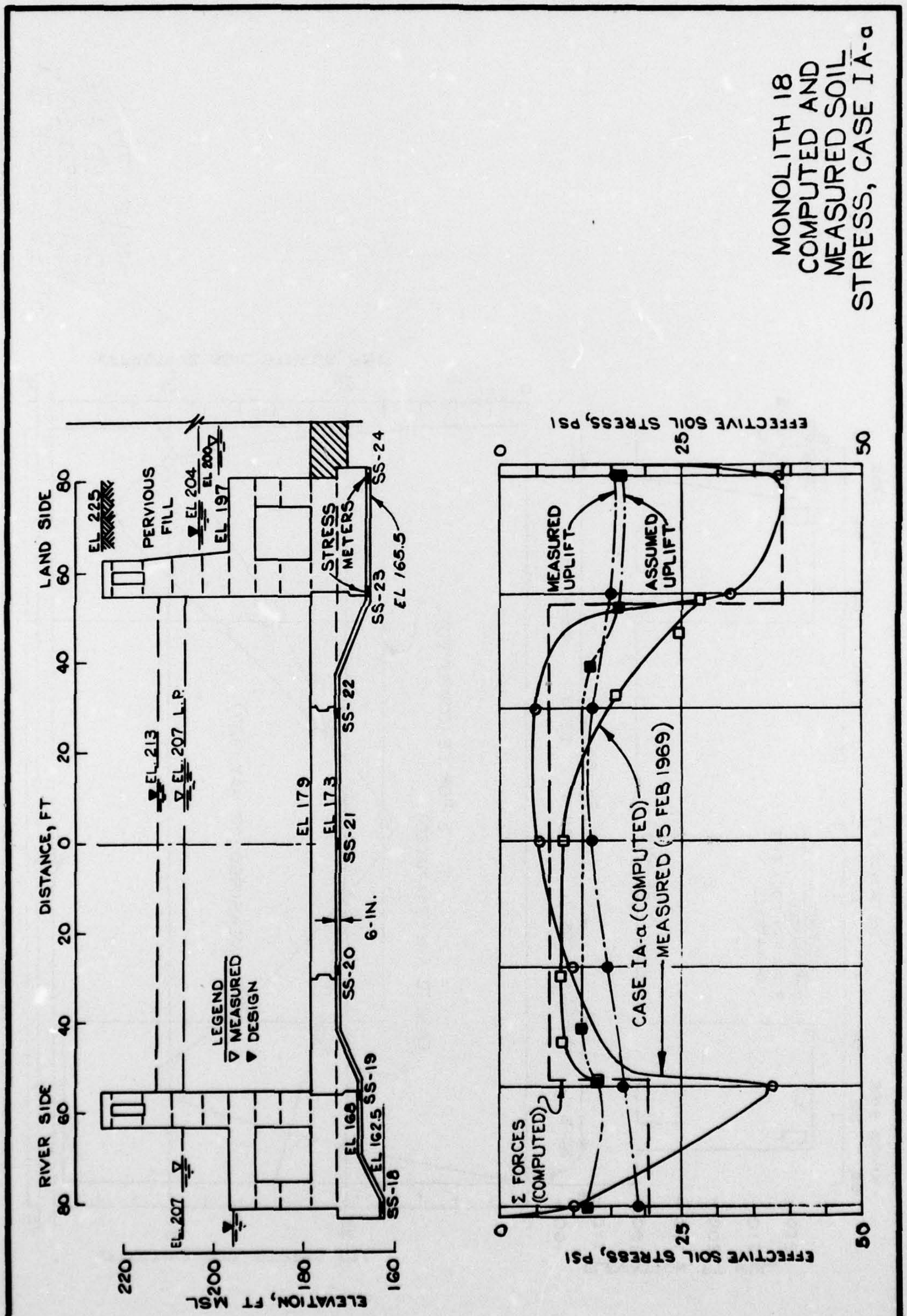
DESIGN CASES



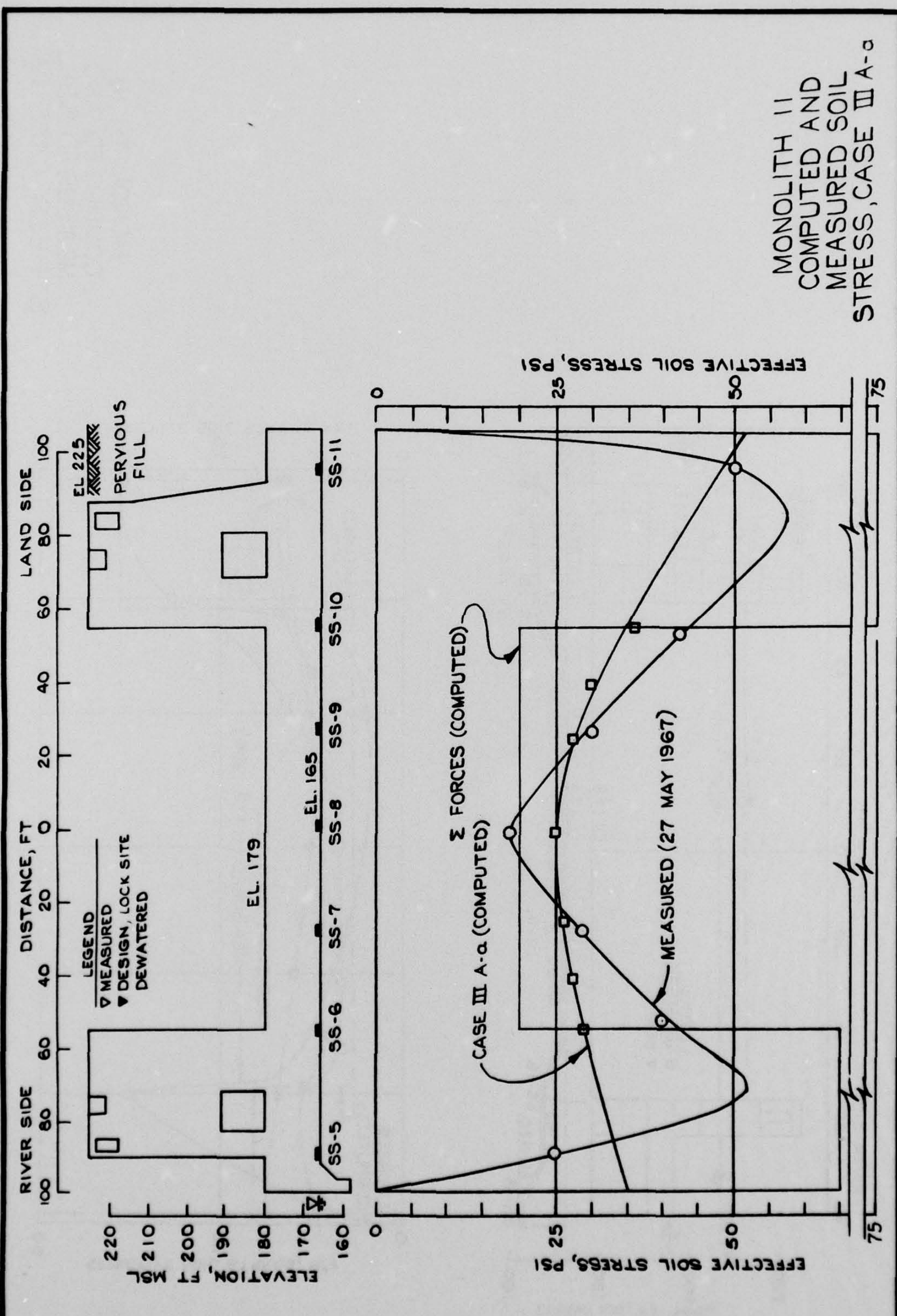
MONOLITH 18
COMPUTED AND
MEASURED SOIL
STRESS, CASE III A-a



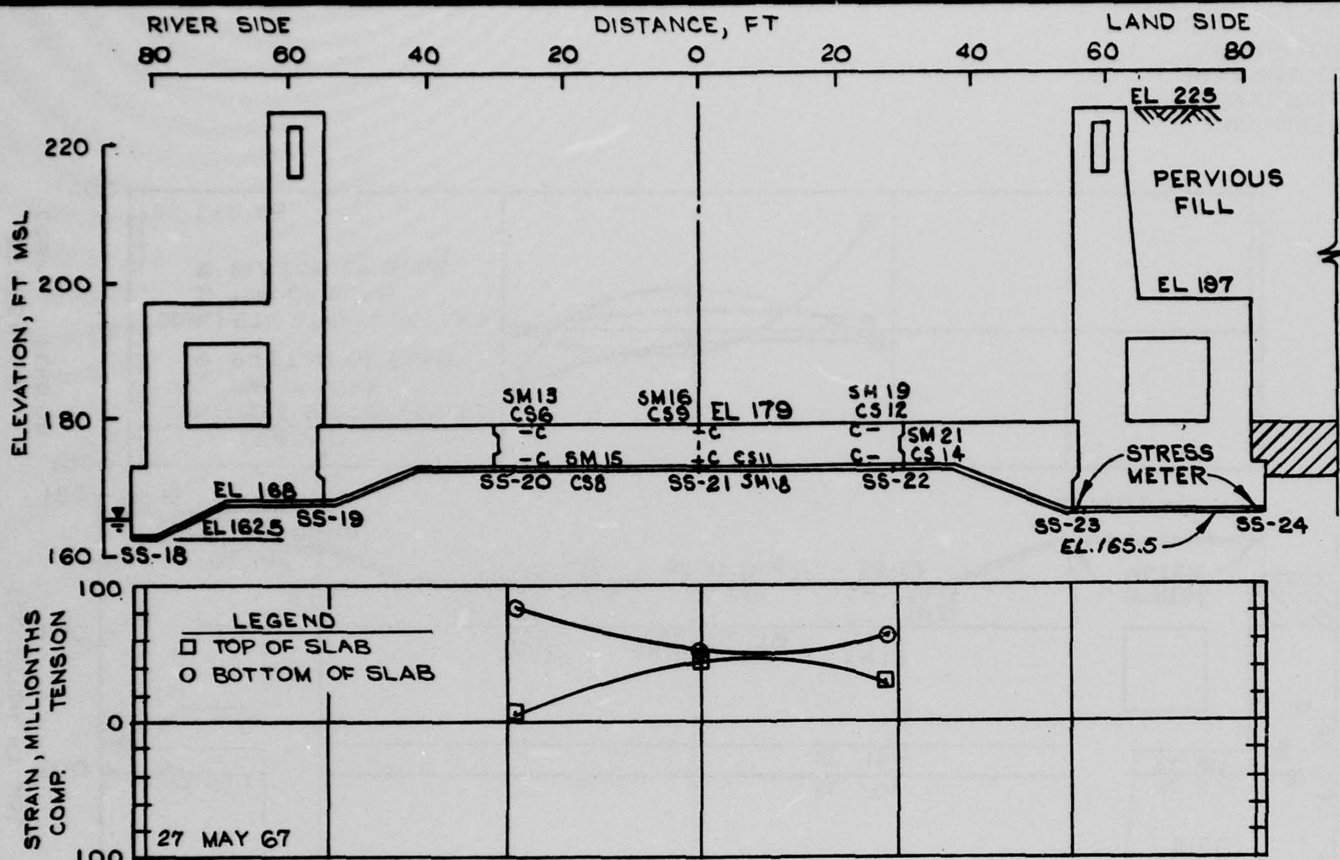
MONOLITH 18
COMPUTED AND
MEASURED SOIL
STRESS, CASE Ia



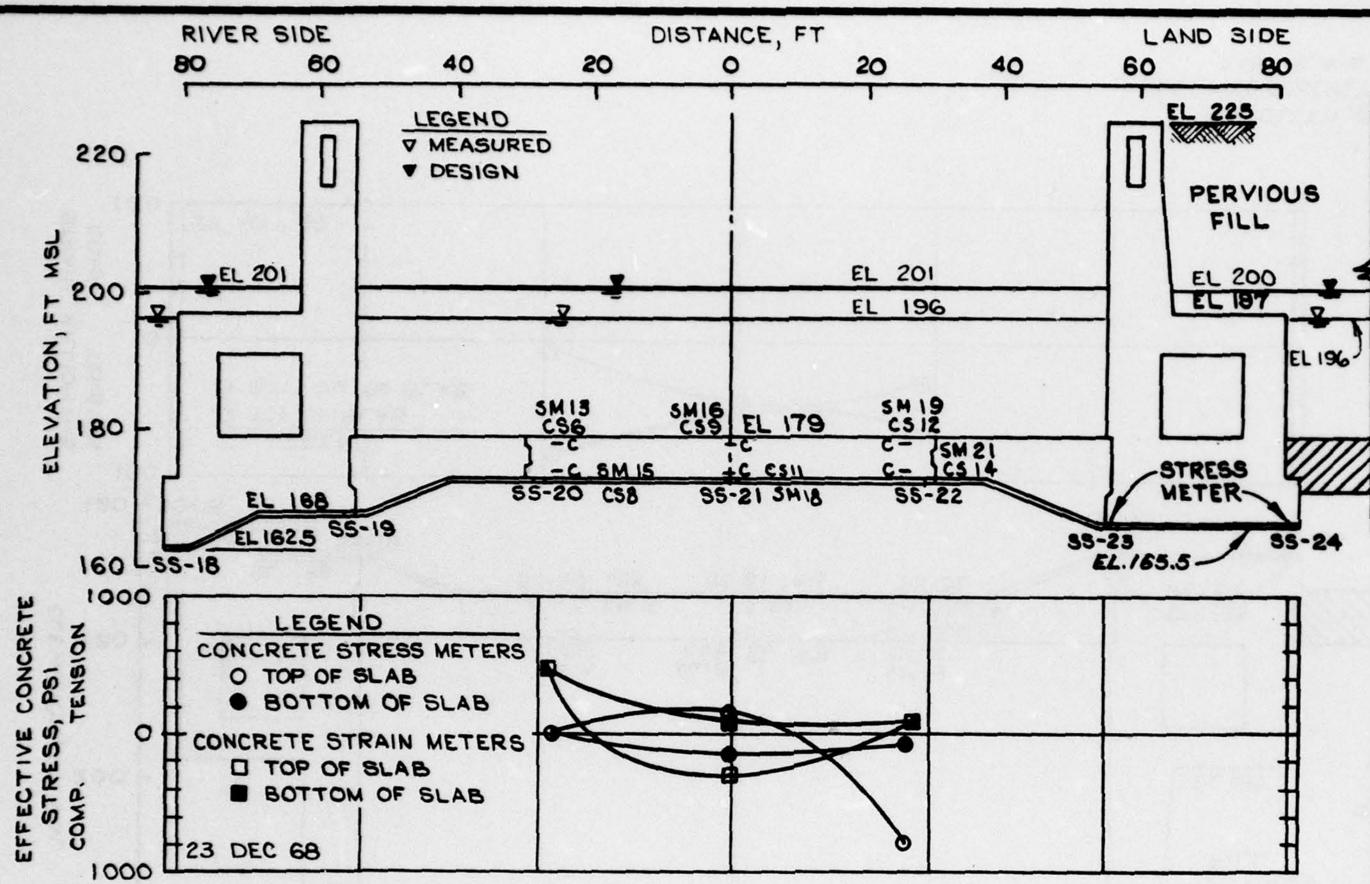
MONOLITH 18
COMPUTED AND
MEASURED SOIL
STRESS, CASE IA-α



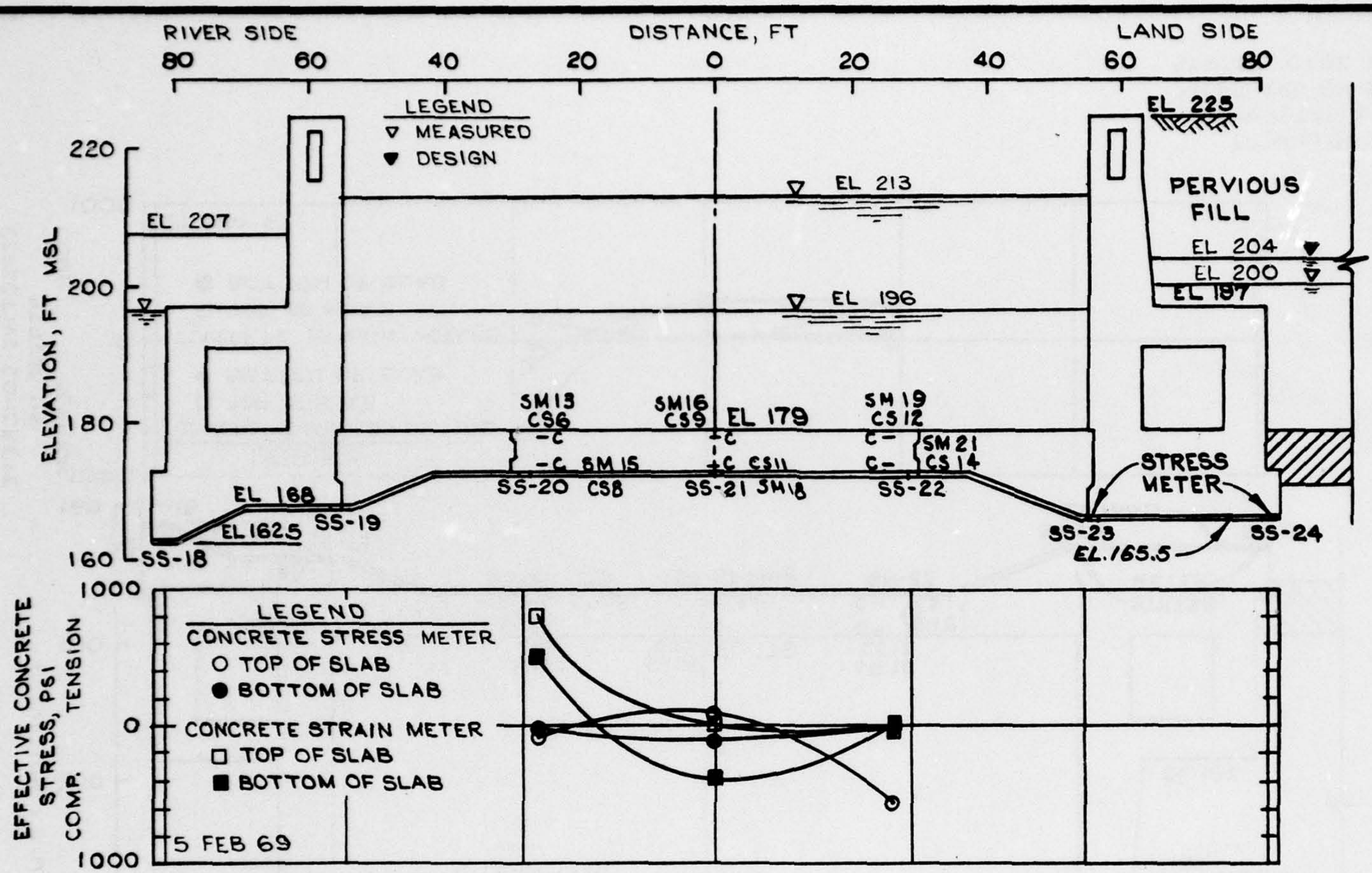
MONOLITH 11
COMPUTED AND
MEASURED SOIL
STRESS, CASE III A-a



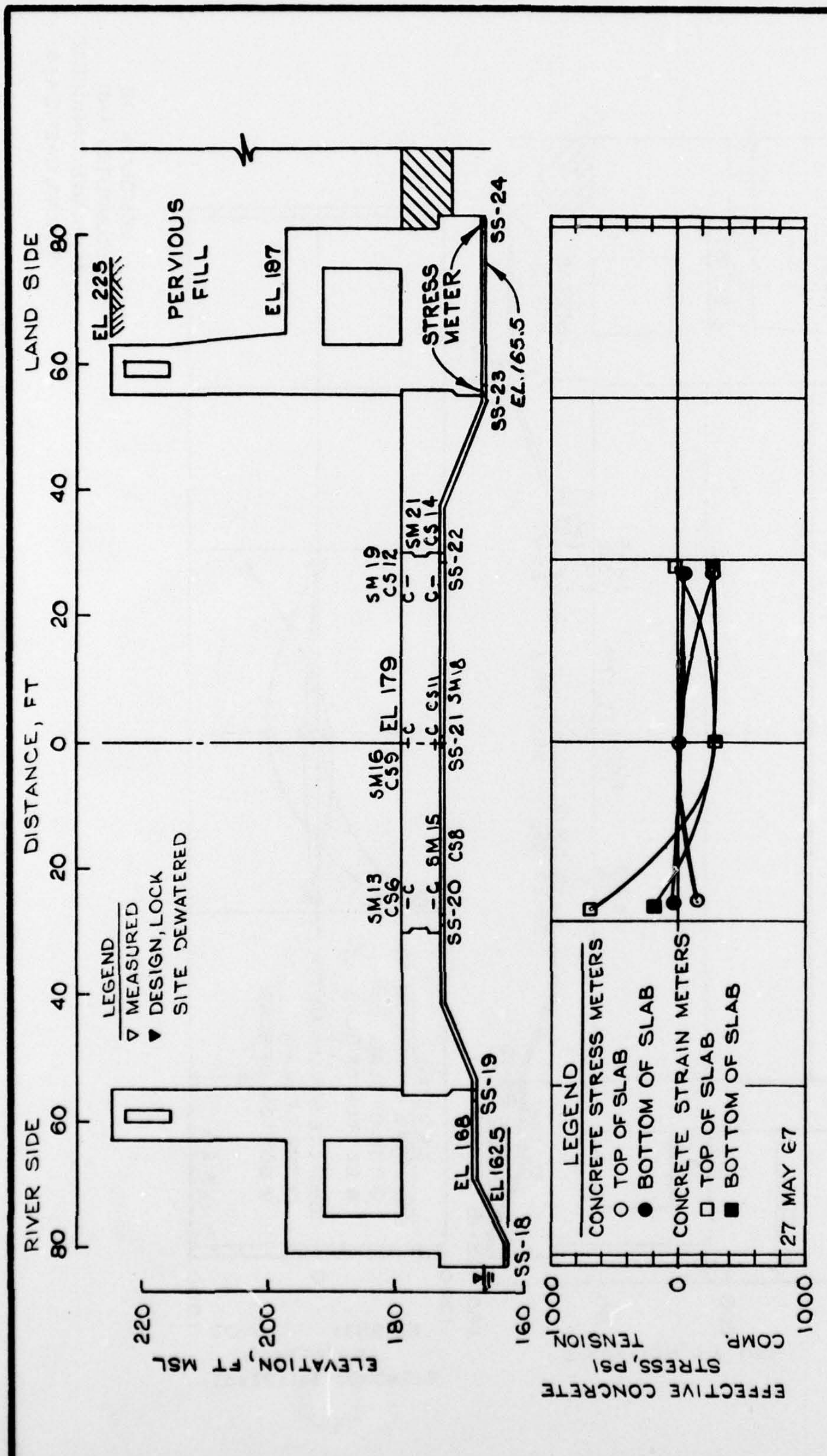
MONOLITH 18
OBSERVED CONCRETE STRAIN
CASE III A-a



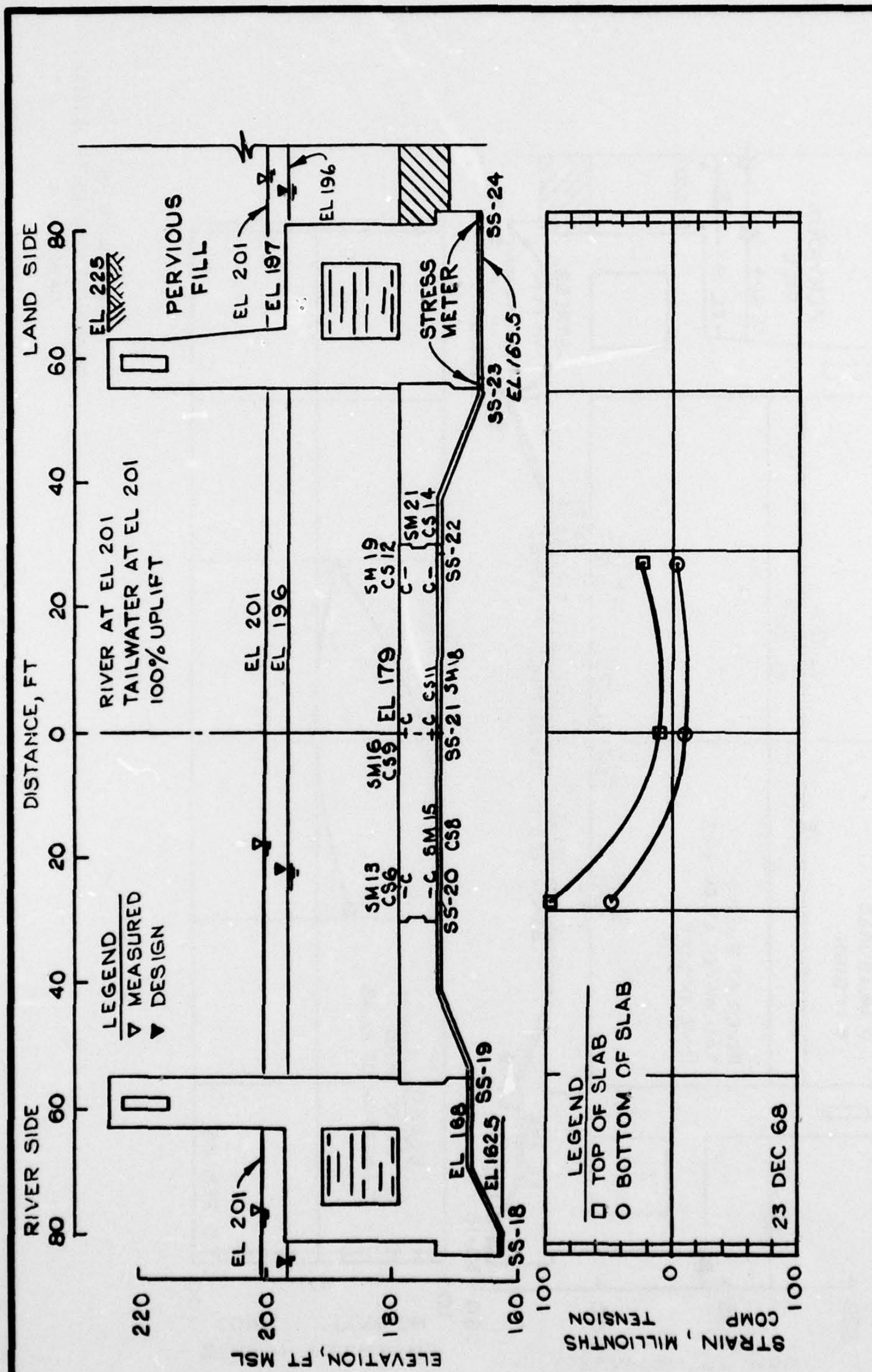
MONOLITH 18
COMPUTED AND
MEASURED CONCRETE
STRESS, CASE Ia



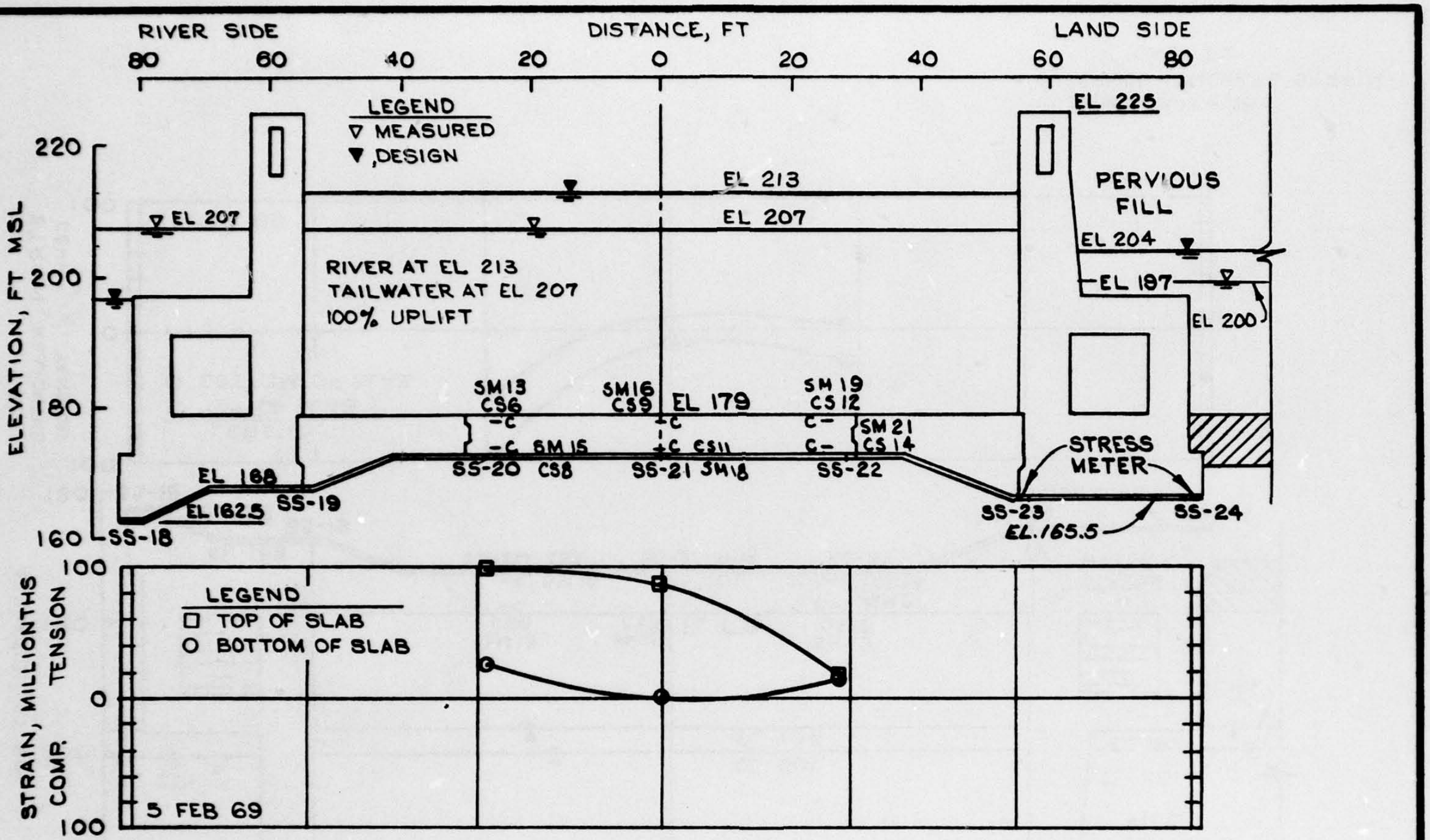
MONOLITH 18
COMPUTED AND
MEASURED CONCRETE
STRESS, CASE I A-a



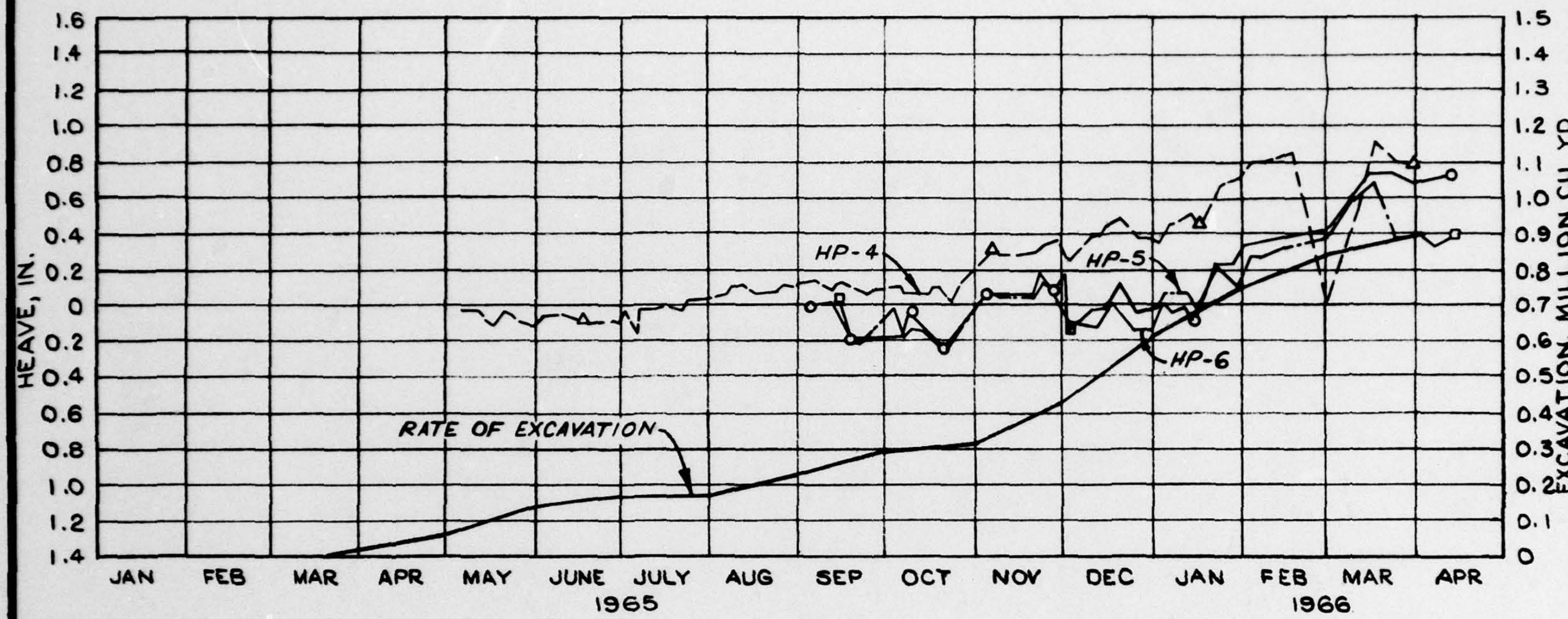
MONOLITH 18
COMPUTED AND
MEASURED CONCRETE
STRESS, CASE III A-a



MONOLITH 18
OBSERVED CONCRETE STRAIN
CASE Ia



MONOLITH 18
OBSERVED CONCRETE STRAIN
CASE IA-a



OBSERVED REBOUND
UNDER THE LOCK

In accordance with letter from DAEN-RDC, DAEN-ASI dated 22 July 1977, Subject: Facsimile Catalog Cards for Laboratory Technical Publications, a facsimile catalog card in Library of Congress MARC format is reproduced below.

Leach, Roy E
Instrumentation observations from the U-frame lock of the Arkansas River Lock and Dam 5 / by Roy E. Leach. Vicksburg, Miss. : U. S. Waterways Experiment Station ; Springfield, Va. : available from National Technical Information Service, 1978.
13, [1] p., 91 leaves of plates : ill. ; 27 cm. (Miscellaneous paper - U. S. Army Engineer Waterways Experiment Station ; S-78-11)
Prepared for Office, Chief of Engineers, U. S. Army, Washington, D. C., under CWIS 31203.

1. Instrumentation. 2. Lock and Dam No. 5, Arkansas River. 3. Locks (Waterways). 4. Measuring instruments. 5. U-frame locks. I. United States. Army. Corps of Engineers. II. Series: United States. Waterways Experiment Station, Vicksburg, Miss. Miscellaneous paper ; S-78-11.
TA7.W34m no.S-78-11